hemical
gineering
A McGRAW-HILL PUBLICATION
how to cope with
AIR POLLUTION

The Shell chemicals listed below are sources of many important commercial products.

Take a closer look in a different light...

A closer look at familiar things in a different light often helps us recognize many interesting and attractive features. This close-up photograph of a diamond in a red light gives us a dramatic new perspective on this familiar gem.

The Shell chemicals in the column at the right may be familiar to you. But a closer look in a different "light" may lead to new and profitable products for your company.

Each of the listed chemicals is used in manufacturing many other important industrial materials. Their reactivity leads to an extensive and growing chemistry that is well worth your investigation. All listed products are available in commercial quantities.

Your Shell Chemical representative will gladly help you take a closer look at the many practical applications of these or other Shell chemicals. Samples and technical literature are available at your request.

Allyl Alcohol
Allyl Chloride
Bisphenol A
Dimethyl Ketone
Epichlorohydrin
Ethyl Amyl Ketone
Hexylene Glycol
Hydrogen Peroxide
(including 90 per cent)
Methyl Isobutyl
Carbinol

SHELL CHEMICAL CORPORATION
INDUSTRIAL CHEMICALS DIVISION

Atlanta • Chicago • Cleveland • Detroit • Houston • Los Angeles • Newark • New York • San Francisco
IN CANADA: Chemical Division, Shell Oil Company of Canada, Limited, Montreal • Toronto • Vancouver

SHELL

ELECTRODYNE®

AUTOMATIC VALVE CONTROLS

. . . now a product of HUPP

Pioneered and Produced for Over 35 Years by...

CUTLER-HAMMER VALVE CONTROL

HUPP Aviation Company is pleased to announce its purchase of the Valve Control Division of Cutler-Hammer, Inc. of Milwaukee.

HUPP is now manufacturing valve control units in its Chicago plant, under the new name of *Electrodyne Automatic Valve Controls,* and assumes full responsibility for parts and service on the thousands of Cutler-Hammer units now in operation. *Electrodyne Valve Controls* are competitively priced and adaptable to any make and size of valve.

HUPP *Electrodyne Valve Controls* are sold through a nation-wide organization of factory-trained manufacturing representatives who are fully qualified for field service.

Write for prices and other data on *Electrodyne Valve Controls.* Information will be furnished promptly by the HUPP representative in your area.

ELECTRODYNE DIVISION

HUPP AVIATION Company

DIVISION OF HUPP Corporation

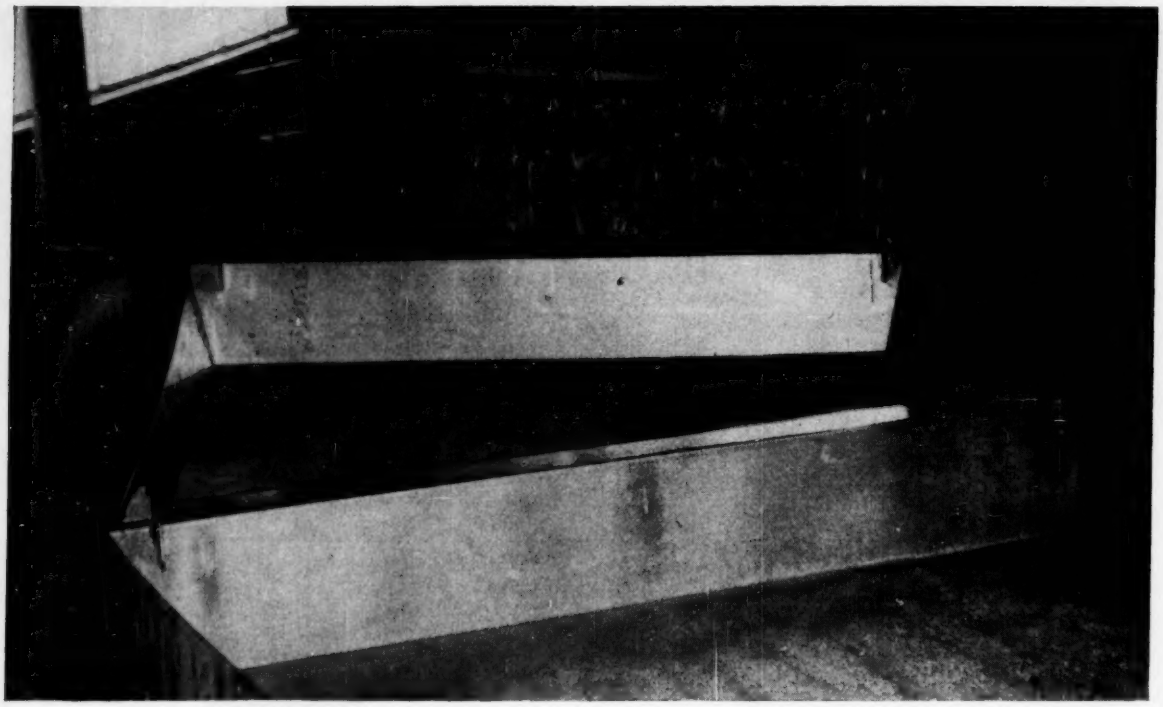
6633 WEST 65th STREET • CHICAGO 38, ILLINOIS • POrtsmouth 7-2100

ELECTRODYNE VALVE CONTROLS...HYDROID GEAR PUMPS AND MOTORS...PRECISION INDUSTRIAL, AIRCRAFT AND MISSILE GEARING AND COMPONENTS

You Can Exactly Duplicate Laboratory Results with the

BIRD-PRAYON

Horizontal Tilting Pan Vacuum Filter



Here is one of the few pieces of full scale plant equipment that you can count on to produce results in tons *identical* with the results in ounces you produce in the laboratory.

The Bird-Prayon Filter works for all the world like a series of giant-size Buechner funnels operating automatically. It gets the solubles out of the cake with minimum wash liquor.

It permits up to six counter current washing steps, each sharply separated from the other.

For information on capacity, construction and cost, get in touch with our nearest office.

BIRD-PRAYON *Horizontal Tilting Pan Filter*

BIRD MACHINE COMPANY, South Walpole, Massachusetts

Regional Offices: Evanston, Illinois • Alamo, California • Atlanta 9, Georgia

August 10, 1959 **Chemical Engineering** Vol. 66 No. 16

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*FREE—for your files—Check Reader Service postcard (p. 209) for an extra copy of this guide to longer service life for exchangers.

Contents continued . . . turn page

A significant new development in chemical mixing methods

The Smith Turbine Mixer is a remarkable new unit designed to give theoretical dispersion of particle size and ingredient to a wide range of dissimilar or disproportionate chemicals.

The Smith Turbine is a very high speed rotary mixer which actually propels the materials in a swift blending, braiding, folding action that mixes without mashing — coats without crushing. There are no wheels to "grind" ingredients or alter particle size—only efficiently shaped blades that provide intensive controlled turbulence without dead spots.

This high-speed action means high production from a small-sized mixer. Turbines are especially compact, require no special installation, and are so vibration-free they can be operated in close proximity to delicate laboratory instrumentation without disturbing it.

Smith Turbines are available in production sizes as large as 53 cu. ft. Capacity alone is a poor guide to performance, however, since the Turbine turns out batches so much faster than any other type of mixer. Sizes range down to the 2½ cu. ft. model — ideal for lab or pilot plant work . . . just right for forecasts and feasibility tests.

Incidentally, a wide range of mechanical modifications can be had to suit specific mixtures. If you've a knotty special problem, we'll be glad to work with you in developing a solution. Lab-size test equipment will be set up in your plant without obligation.

Impressed? Then investigate! A letter or phone call will bring quick action on additional information — or even a test demonstration in *your* plant using the very chemicals you mix! Fair enough? Then contact us today!

Ultra
High-Speed

Extra Thorough
Mixing

Unusually
Compact

THE SMITH TURBINE-TYPE MIXER

SMITH

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Milwaukee 1, Wisconsin • Lufkin, Texas
Affiliated with Essick Manufacturing Company, Los Angeles, California

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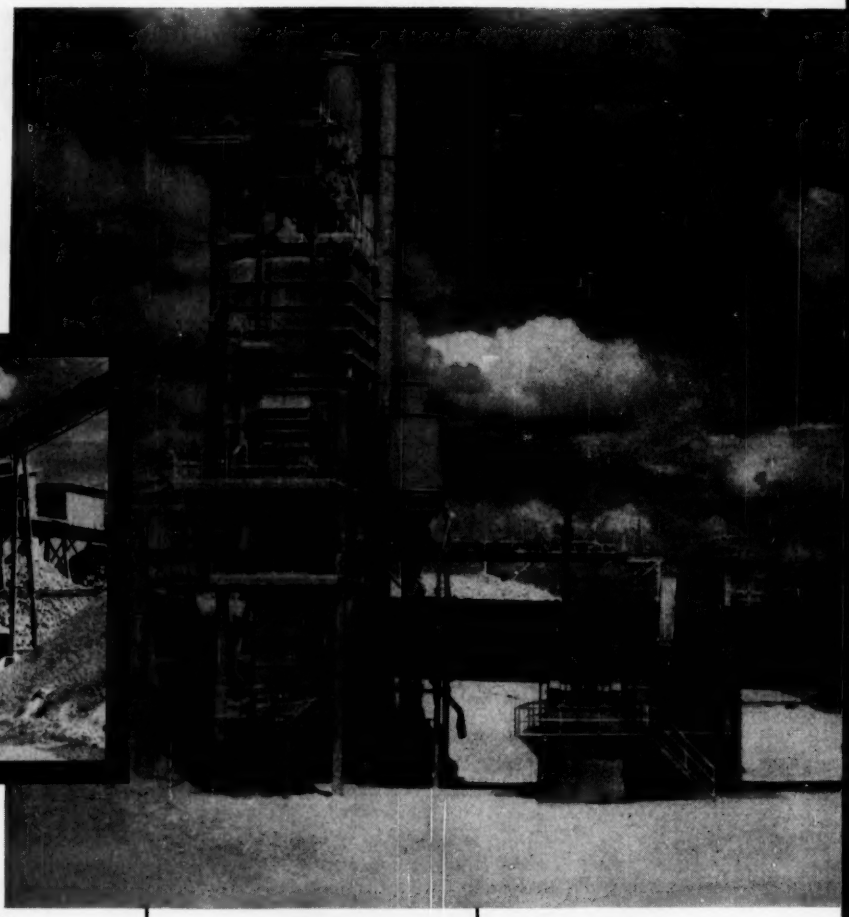
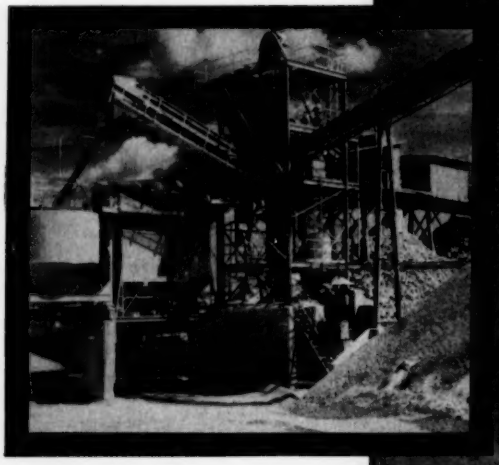
KENNEDY COMPLETE LIME PLANTS

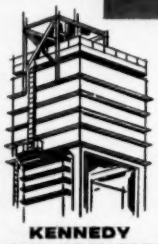
The New Braunfels, Texas plant of U. S. Gypsum Co. where a KENNEDY Rotary Kiln installation has been added to an existing shaft kiln operation to provide highest quality lime product while utilizing stone sizes previously discarded.





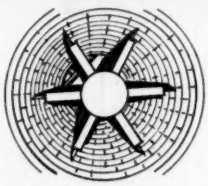
KENNEDY STONE PREPARATION PLANT

Featuring KENNEDY crushing, screening and conveying equipment in integrated arrangement for balanced output of correct sizes.



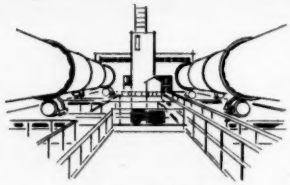
KENNEDY STONE PREHEATER

Puts kiln exit gases to work to partially calcine feed. The development which made the rotary kiln the most economical producer of high quality lime.



KENNEDY INTERNAL HEAT RECUPERATOR

"MULTIVANE" design of steel castings—properly located to resist abrasion—scientific configuration of vanes to provide maximum transfer of heat and movement of material.



KENNEDY 2-TIRE ROTARY KILN

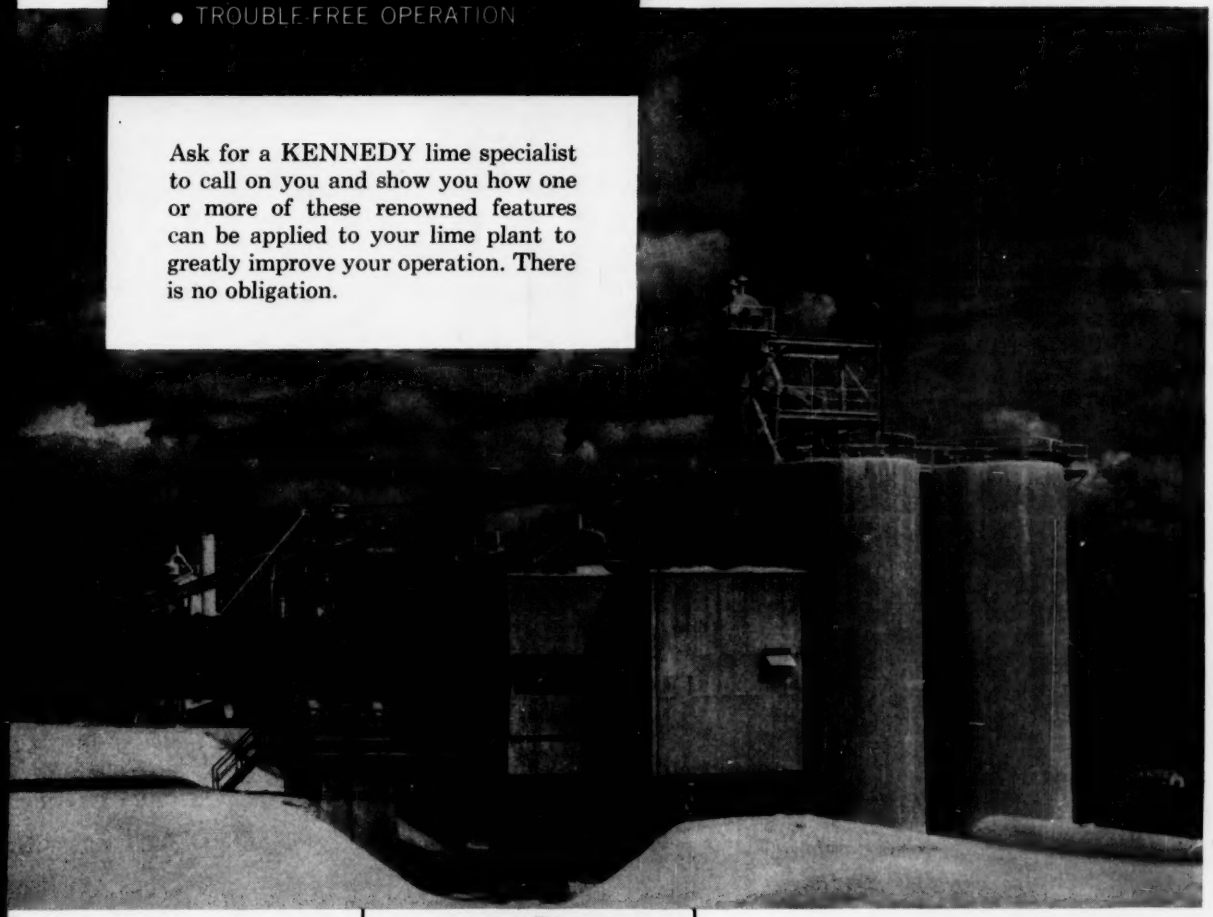
KENNEDY heat-saving auxiliary equipment makes 3-tire or 4-tire kiln unnecessary. Less kiln to buy—less kiln to maintain—less brick—fewer foundations; simpler alignment.

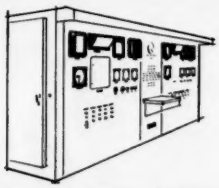
LIME PLANT EQUIPMENT

combines

- MOST MODERN DESIGN
- LOWEST FUEL CONSUMPTION
- HIGHEST QUALITY PRODUCT
- TROUBLE-FREE OPERATION

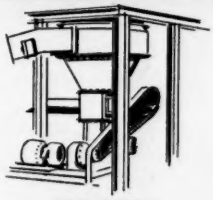
Ask for a KENNEDY lime specialist to call on you and show you how one or more of these renowned features can be applied to your lime plant to greatly improve your operation. There is no obligation.





KENNEDY CENTRALIZED KILN CONTROL

Single attractive cubicle houses all essential instruments and controls for system operation. Factory-assembled and checked to minimize installation, and insure efficient overall operation.



KENNEDY CONTACT COOLER

Rapidly reduces temperature of discharged lime by efficient transfer of heat to combustion air.

KENNEDY VAN SAUN

MANUFACTURING & ENGINEERING CORPORATION

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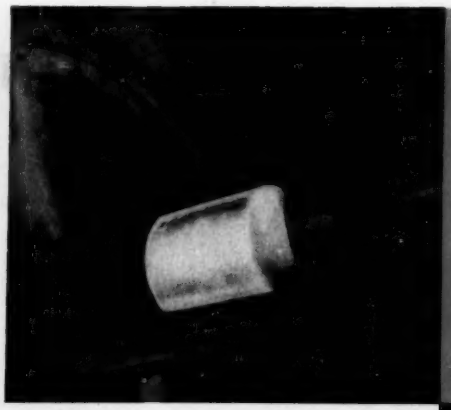
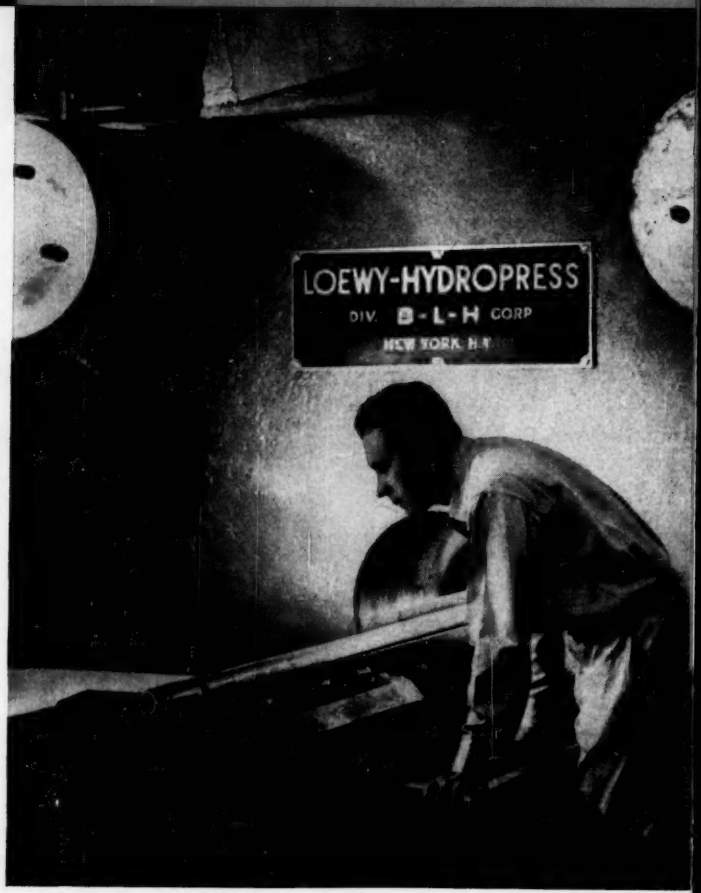
How lasting quality is Heat Exchanger



Heated billet ready for insertion into extrusion press.

2 EXTRUDING

(SECOND OF A FIVE-PART SERIES)



Billet emerges from extrusion press as a heavy-walled tube, or shell.

built into Phelps Dodge and Condenser Tubes...

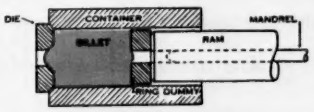
Phelps Dodge heat exchanger and condenser tubes are formed from billets by the hot-forged extrusion process, a method that produces sturdy, seamless tubes with long service life, finest properties and precise dimensions.

The metal billet, before being placed within the container of the extrusion press, is first heated in a controlled atmosphere to a temperature predetermined for each specific alloy. The subsequent forging (upsetting) and extruding operations are combined in a simultaneous operation.

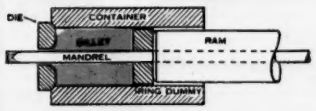
The billet is forged by a compression system using several million pounds of hydraulic pressure. This operation refines the grain and achieves maximum densification of the billet. Finally, a highly polished steel mandrel is used to pierce the billet, thus forcing extrusion of the metal over and around the mandrel and through a steel die into the form of a heavy wall tube.

Throughout the entire tube fabricating operation—from raw materials to finished product—quality is the keynote. That's why Phelps Dodge tubes are preferred by those who demand the finest . . . the manufacturers and users of heat exchangers and condensers.

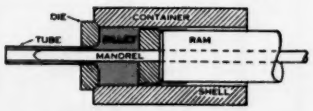
Billet is placed within container for forging operation.



Heated billet is forged within container through action of the ram pressing on the ring dummy-block.



Steel mandrel pierces billet just before extrusion takes place.



Hydraulic pressure exerted on ram and ring dummy-block causes metal to flow over mandrel and through die.

PHELPS DODGE COPPER PRODUCTS CORPORATION

First for Lasting Quality—from Mine to Market!

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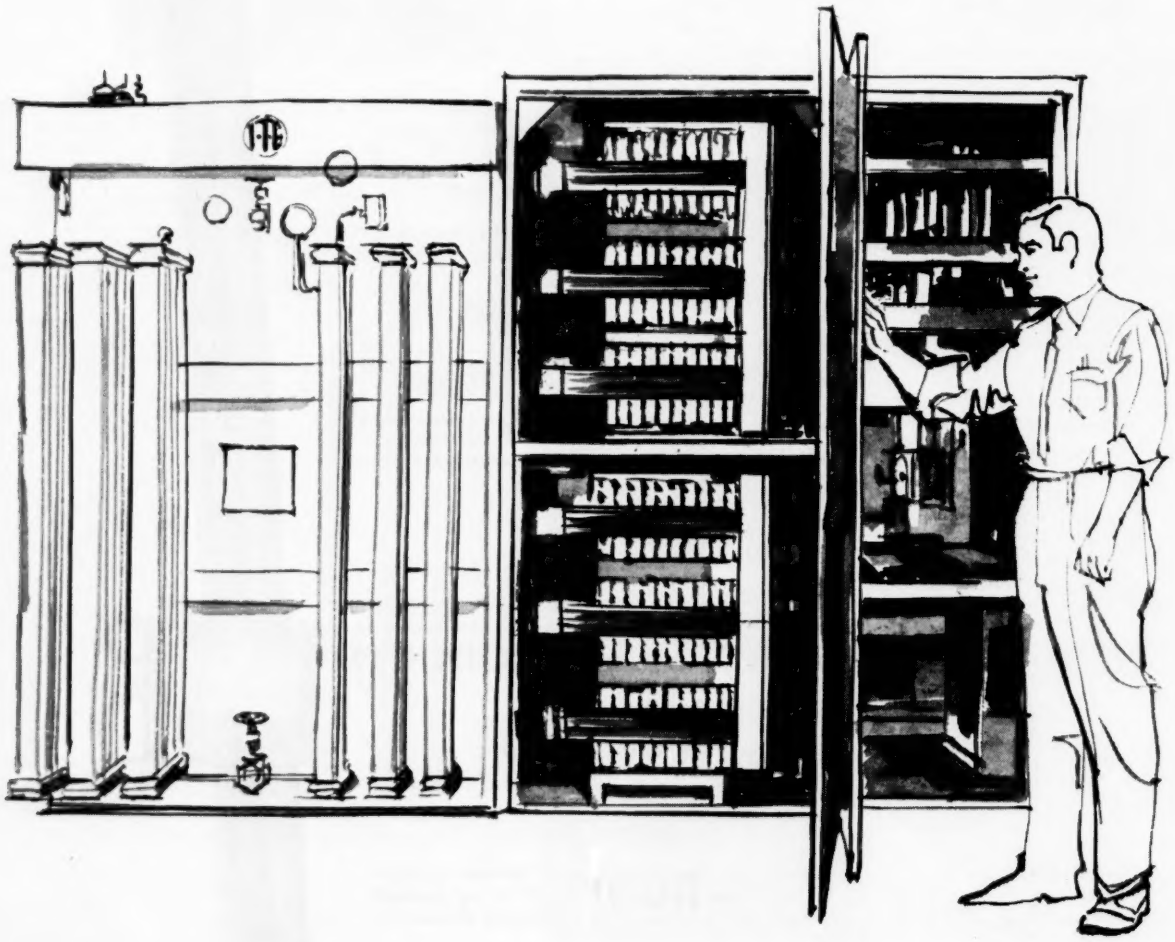
D-C POWER PACKAGE

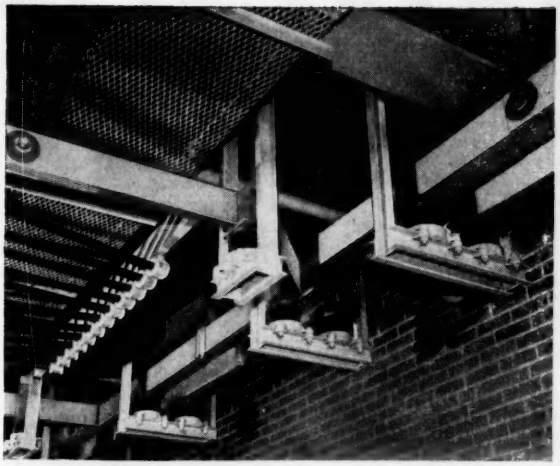
FOR ELECTROLYTIC PROCESSES

Only the I-T-E UNITRON Semi-Conductor Rectifier lets you select cells at random. Instead of having to code cells for use in various positions, you can use any cell in any position. This is because the unique I-T-E voltage divider and current balancing circuits maintain equal inverse voltage and equal current on all cells. So they have greater assurance of long life.

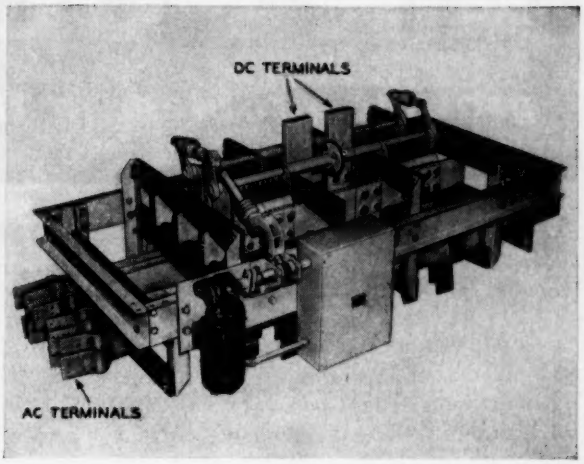
The UNITRON saves you money in the cooling system too. It uses a closed circuit water cooling system which continuously purifies and deionizes the water. This cooling method eliminates the need for power-eating blowers and space-eating ducts. It saves the cost of special coolants. And it's so effective it significantly prolongs cell life.

The I-T-E UNITRON can be built in any desired d-c voltage and current rating required for your application.

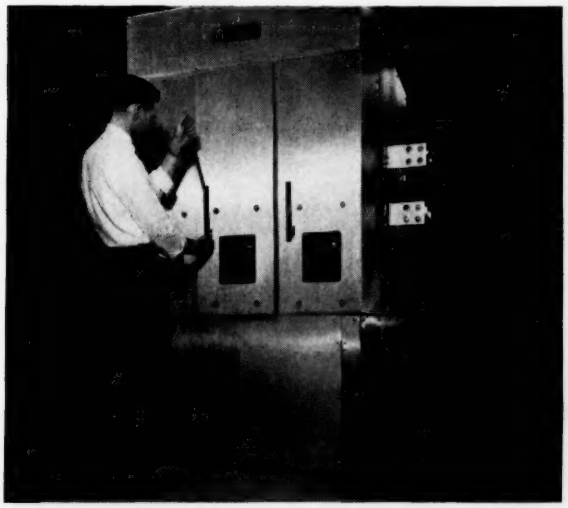




CONDUCTION. I-T-E prefabricated bus comes to you completely engineered down to the last detail . . . including connectors, fittings and bus supports. Number, size and configuration of conductors are carefully specified to insure desired conductivity, high strength, adequate thermal capacity, and low losses. Parts are formed, punched and marked to permit fast, accurate field assembly. All joints are high pressure, with silver-to-silver contact.



CONTROL. Type CR electrolytic cell and bus switches pack enormous capacity into a much smaller space than conventional knife switches. Individual units are furnished in two sizes, 3000 and 6000 amp, and are rated at up to 250 volts. They may be easily paralleled for any desired current capacity. Switch is designed so that contacts may be replaced without dismounting. Long life and dependability proved in service for many years.



PROTECTION. Type FB anode circuit breakers from I-T-E limit arcback current to 60,000 amp or less on large mercury arc rectifier systems. Novel arrangement of 6-pole breaker permits removal of single pole without interrupting service. You can replace a breaker in 3 minutes. Each pole is complete in itself. FB breakers can be equipped with reclosing controls for completely automatic protection of unattended stations.

CI-3

I-T-E Circuit Breaker Company
1900 Hamilton St., Philadelphia 30, Pa.

- ☐ UNITRON rectifier
- ☐ Type FB circuit breakers
- ☐ Prefabricated bus
- ☐ Type CR switches
- ☐ Primary unit substations
- ☐ K-LINE LV switchgear (600 v)
- ☐ Other.....

Name.....Title.....

Company.....

Street.....

City.....Zone.....State.....

SEND COUPON

Get complete, up-to-date information on I-T-E equipment

I-T-E CIRCUIT BREAKER COMPANY

AIR POLLUTION

growing problem in the chemical industry

Chemico Gas Scrubbers in 415 Installations Provide 90-99.95% Removal Efficiency

"It is unpleasant at best, and can be fatal," is the sum-up by at least one expert about air pollution. The question generally posed is simply, "What can be done about it?"

The chemical processing industry *is* doing something about it. Chemico Venturi gas scrubbers have already been installed for a variety of chemical processes. One reason: the extreme adaptability of this equipment.

ADAPTABILITY PAYS DIVIDENDS FOR MOST PROCESSES

Depending on local conditions, regulations and operating requirements, Chemico equipment can be tailored to solve a wide variety of pollution control problems. Initial installation can be designed to meet minimum needs. If experience or changing conditions call for increased efficiency, this can be achieved to almost any degree with original equipment by merely increasing the power input. Where power costs are a factor, this flexibility feature of Chemico scrubbers is an important advantage.

SIMPLE CONSTRUCTION SAVES MAINTENANCE COSTS

Design simplicity of Chemico Venturi gas scrubbers means that it is possible to utilize materials resistant to corrosion, abrasion or high temperature. This, plus the fact that no critical controls are necessary, holds maintenance costs to the barest minimum. In addition, the small space requirements and complete flexibility of arrangement of Chemico Venturi scrubbers permit installation in existing plants where space is at a premium.

TYPICAL INSTALLATIONS

IRON & STEEL INDUSTRY —
Gray Iron Cupola; Oxygen Steel Converter; Steel Open Hearth Furnace (Scrap); Steel Open Hearth Furnace (Oxygen Lanced); Blast Furnace (Iron); Electric Furnace; Rotary Kiln-Iron Reduction; Crushing & Screening.

CHEMICAL INDUSTRY —
Acid-Humidified SO_3 (a) Scrub with Water (b) Scrub with 40% Acid; Acid Concentrator; Copperas Roasting Kiln; Chlorosulfonic Acid Plant; Dry Ice Plant; Wood Distillation Plant; $TiCl_4$ Plant, TiO_2 Dryer; Spray Dryers; Flash Dryer; Potassium Phosphate; Chemical Incinerator.

NON-FERROUS METALS INDUSTRY —
Blast Furnace (Sec. Lead); Reverberatory Lead Furnace; Ajax Furnace-Magnesium Alloy; Zinc Sintering; Reverberatory Brass Furnace.

MINERAL PRODUCTS INDUSTRY —
Lime Kiln; Asphalt Stone Dryer; Cement Kiln; Dolomite Kiln; Magnesia Kiln.

PETROLEUM INDUSTRY —
Catalytic Reformer; Acid Concentrator; TCC Catalyst Regenerator.

FERTILIZER INDUSTRY —
Fertilizer Dryer; Superphosphate Den & Mixer.

PULP & PAPER INDUSTRY —
Lime Kiln; Black Liquor Recovery Boiler.

MISCELLANEOUS —
Pickling Tanks; Boiler Flue Gas; Sodium Disposal Incinerator.

FULL DETAILS AVAILABLE—For your copy of a new brochure giving complete data on Chemico Venturi gas scrubbers or for technical assistance on a specific problem, write to the address below.

CHEMICO

CHEMICAL CONSTRUCTION CORPORATION
525 West 43rd Street, New York 36, New York

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Safe-pouring space savers that stack up...

HACKNEY STAINLESS STEEL CHEMICAL CONTAINERS

Here are the chemical containers everybody likes—shippers, carriers, handlers, users! Lightweight, strong, leakproof and stackable, they protect your dangerous or corrosive products, eliminate accidental breakage, and safeguard handlers.

Hackney chemical containers are built of Types 304 and 316 stainless steel. Bottom foot ring fits snugly over the top ring of the barrel beneath to permit safe stacking. That means real savings in warehouse space and handling time. Full-curled top and bottom rings give handlers full gripping areas. Dropping and spilling are cut to a minimum. And for further safety, a splashproof pouring spout is available as an optional accessory.

Hackney chemical containers hold approximately 15½ gallons of liquid. Size: approximately 17 5/16" x 22⅛". Owner's name can be embossed in foot ring. For more details, write to the address below.

Pressed Steel Tank Company

Manufacturer of Hackney Products

1447 South 66th Street, Milwaukee 14, Wisconsin

Branch offices in principal cities

CONTAINERS AND PRESSURE VESSELS FOR GASES, LIQUIDS AND SOLIDS

DOW | CHEMICAL RESEARCH makes old theories pay off

Dusty old chemical phenomena, like ion exchange and chelation, for years were considered only academically interesting. Now they're being re-examined, probed by further experimentation, and applied to revolutionized modern chemical processing. And today's advances are only an in-between step to new and more profitable applications in the future. This series of chemical news notes will help you keep abreast of these developments.

You may wish to check certain items in this advertisement and forward to those concerned in your company.

ROUTE TO:

_____

_____

_____

_____

NEW ION EXCHANGE RESIN WITH "MUSCLES" STARS AS CATALYST

Nearly a century after the discovery of the ion exchange principle, and fifty years since the first industrial application of ion exchange resins—Dow research chemists at Midland have developed a new ion exchange resin with until-now-unheard-of stability—one that will herald new advances in catalytic processes. This remarkable material is Dowex® 50W.

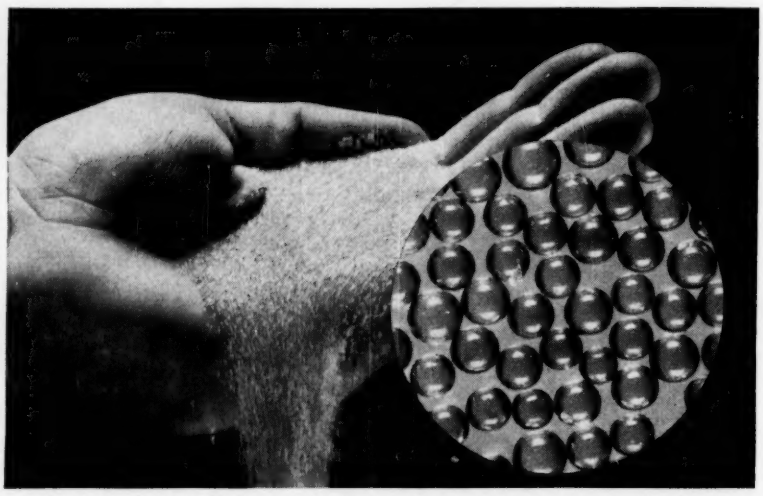
For as long as chemical engineers have been using ion exchange resins as catalysts, researchers have been trying to develop a product with a low metal content, plus excellent physical and chemical stability.

With the development of Dowex 50W, Dow has come up with a tough, high-stability, high-capacity ion exchange resin that gives outstanding performance as an insoluble acid for catalytic reactions. A constant quality-control check on its physical and chemical properties reveals a minimum of breakage, even under extreme conditions.

Ion exchange resins are employed commercially for catalyzing the epoxidation of unsaturated oils to produce superior plasticizers and stabilizers. Other catalytic reactions for which ion exchange resins have demonstrated unique advantages include esterification, hydrolysis, condensation, sucrose inversion and alcohol dehydration.

Combining all the advantages of a solid, substantially insoluble catalyst, Dowex 50W is easy to separate by filtration or decantation after the reaction is completed; reduces operating costs by its ability to be reused repeatedly—without regeneration; minimizes corrosion problems; increases yields and efficiency. As an extra cost-saving benefit, the resins can be supplied in the hydrogen form for use without special preparation. Less than 50 pound quantities of the Dowex resins are available as "Baker Analyzed" Reagent Dowex Ion Exchange Resins, from the J. T. Baker Company of Phillipsburg, New Jersey, or the Baker distributor in your area.

A hard-cover handbook, "DOWEX: Ion Exchange", covering the entire field of ion exchange from basic principles to processing applications, is yours upon request. Take this opportunity to add to your library of Dow technical literature with this comprehensive, informative 75-page volume.



Crystal-clear, uniform beads of Dowex 50W—the end result of Dow's search for a high-capacity, high-stability ion exchange resin to serve in catalytic reactions.

INTERMEDIATE PRODUCTION FACILITIES: *"short order" service for building blocks*

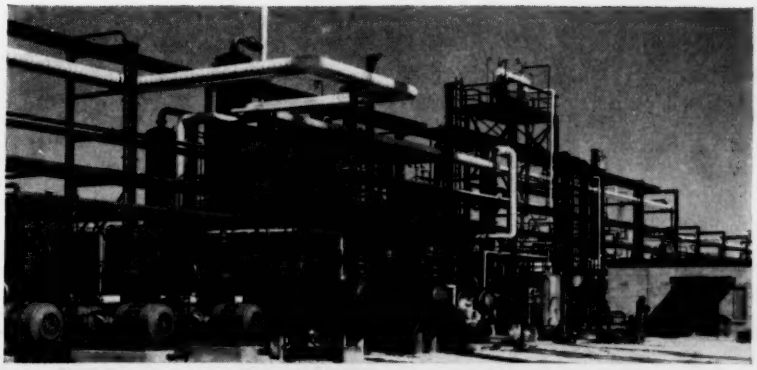
The fanfare that accompanies the announcement of a new intermediate is often followed by a frustrating wait for the product to be made available in commercial quantity. In reality, this time lag between research and full-scale production is necessary for the manufacturer to develop his product and evaluate its market potential.

To help bridge this gap for chemical processors who want to start testing immediately and set up pilot production of their own, Dow has established a new multipurpose plant. The sole function of this plant will be to supply semi-commercial quantities of pharmaceutical intermediates prior to their introduction as regular products.

Later, these "short order" intermediates, like the high-quality basic chemicals in the Dow line, can be supplied in abundance from regular production facilities.

★ ★ ★ ★ ★

IF THESE NEWS NOTES about processing chemicals are helpful we'd like to have your comments. For more information about any Dow chemical discussed in this advertisement, write THE DOW CHEMICAL COMPANY, Midland, Mich., Chemicals Merchandising Department 914AK8-10.



CHELATION: *The specialty that became a commodity.*

Another chemical phenomenon, chelation—like ion exchange—is being recognized as a key problem solver in the chemical processing industry.

Time was, when the process of removing metal ions from water or liquids was just too expensive for many industries and applications. Then along came greater production of chelating agents—like Versene®, Versenol®, and Versenex* from Dow—with subsequent lower cost.

The soap, rubber, paper, formulation, and medical fields all contributed to an expanding market for chelating agents.

And more recently, the economics of chelation have begun to look even better. Because of Dow's new production facilities at the Freeport, Texas plant, the price of Versene, Versenol and Versenex has become much more attractive and many manufacturers are taking a second look at chelating agents as an end to their problems of metallic contamination.

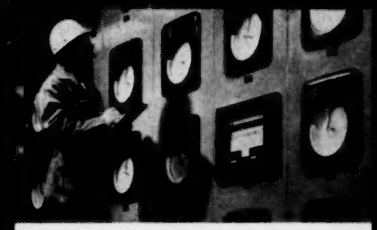
New and different applications are becoming commonplace. Typical is the recent upsurge of interest in scale removal from boilers and heat exchange equipment by chelation.

*TRADEMARK OF THE DOW CHEMICAL COMPANY

MORE NEWSTIPS

CAUSTIC SODA

Dow service and delivery are unsurpassed! Plaquemine, La., caustic plant is the fourth in the nationwide network producing this important basic chemical.

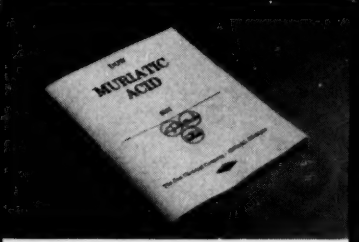


DOWTHERM® A

Pinpoint temperature control—350°F. to 750°F.—is possible with this unique organic heat transfer medium. Reduces fire risk; cuts pressure to 95 psi at 700°F.

METHOCEL®

Water soluble gums with lowest residual ash of any natural or synthetic gum commercially available, have value in metallurgical, ceramic, glass industries.



MURIATIC ACID

Dow's research experience, fast delivery, and technical service ensure satisfaction for HCl customers. Send for informative new Muriatic Acid booklet.

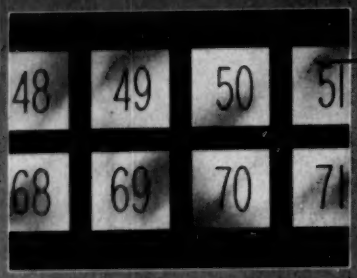
DOW CHEMICALS *basic to the chemical processing industry*

Alkylene Oxides • Glycols • Industrial Preservatives • Polyalkylene Glycols Glycol Ethers • Alkalies • Phenolic Compounds • Brominated and Chlorinated Aliphatic Compounds • Inorganic Acids • Halogens • Organic Acids and Esters Inorganic Chlorides • Bromides and Bromates • Nitrogen Compounds • Amino Acids Glycerine • Salicylates • Phenyl Phosphates • Heat Transfer Media • Flotation and Flocculating Agents • Chelating Agents • Ion Exchange Resins • Methylcellulose Magnesium • Plastics • Aromatics

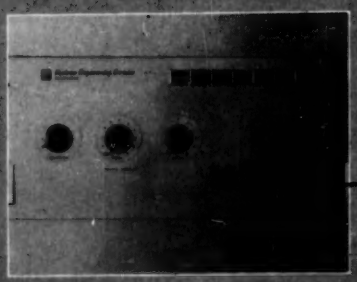
THE DOW CHEMICAL COMPANY
Midland, Michigan

DOW

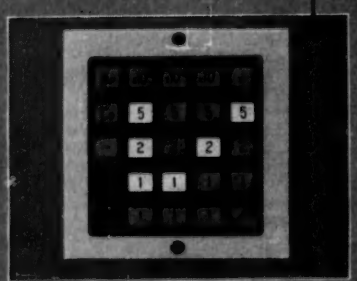
New packaged



THREE 40-POINT ANNUNCIATORS make it easy for the operator to tell at a glance which variables are off-normal.

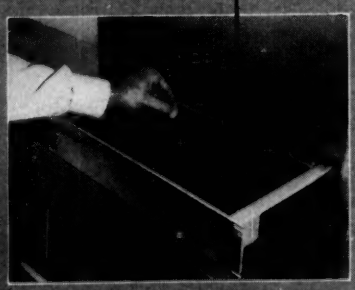


DIGITAL VISUAL DISPLAY and variable selector switches make it easy to select any single variable and watch all trends and changes continuously.



SERVICING IS SIMPLIFIED by an indicator-light panel showing the completion of each step in the analog to digital conversion. The sequence programmer can be changed from automatic to hand advance to permit operator to check each step.

UNIQUE INPUT SELECTOR is unusually dependable because of its sealed, oil-immersed construction. Servicing is normally limited to visual inspection every 6 months. Drawers pull out so voltage checks can be performed without shutting down system.



PINBOARD PROGRAMMING adds flexibility. You can change the logging or scanning sequence at will . . . substitute one type of input for another. Range, span, and zero adjustment are set by inserting pins in their proper places. No calculations are required. The pinboards are pinned in familiar units of measurements.

Honeywell logger-scanner

...accurate within ± 0.1% of reading

...pinboard programming for maximum flexibility

Here's a standard, all-purpose 120-point logger-scanner system with features formerly found only in more expensive, custom-designed equipment . . . the first of several packaged logger-scanners being introduced by Honeywell. It offers the ultimate in accuracy, flexibility, dependability and simplicity of maintenance. Wide ambient temperature operating limits—60 to 120°F—eliminate the need for special air conditioning equipment.

The Series 3120 accepts signals from primary measuring instruments—thermocouples, flow, pressure or other transducers. It measures these signals, digitizes them, and prints their values in immediately usable form. A thermocouple reference oven can be supplied to accommodate three types of thermocouple inputs—types T, J, and K—which are automatically linearized over their entire range to within 0.1% accuracy.

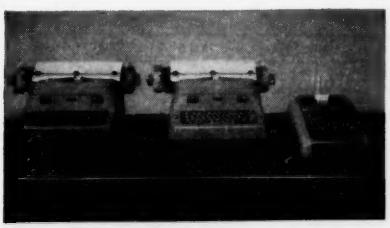
The operator can select either automatically or manually initiated logging cycles. He can set the system to log all variables automatically at preset intervals, or manually energize the system to operate on demand, between logging cycles.

Between logging cycles, the system can scan off-normal alarm points—high, low or both—at a rate of 7 points per second. Upon detecting an off-normal point, the system sounds an alarm, lights a point-identification light, and prints the time, point number and off-normal value on adding machine tape. During log cycles, off-normal points are printed in red on the log sheet.

Get complete details from your nearby Honeywell field engineer. Call him today . . . he's as near as your phone. MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.

Honeywell

H HONEYWELL *First in Control*



TWO TYPEWRITERS permit a single line log allowing columnar comparisons. Separate alarm printer records all off-normal variables.

STANDARD MODULAR COMPONENTS are assembled on chassis mounted as individual drawers in relay racks. All drawers are connected by plugs for easy servicing.

See why ALCOA ALUMINUM makes a good design habit

Requirement: Apply heat to piping when a product must be kept liquid during transfer

Key to Good Design: Use Alcoa UNITRACE, the aluminum pipe with integral steam tracing

The problem of applying heat to product piping can be solved efficiently and economically with ALCOA* Unitrace, the aluminum pipe with the integral steam passage.

In Unitrace, the steam and product passages are extruded as integral segments of a single piece of ALCOA 6063-T5 aluminum alloy. The outside diameter of the entire unit is round like conventional pipe, permitting fast, easy erection with standard type fittings.

With Unitrace, you get the advantages of low cost, easy bending and quick fabrication. Unitrace eliminates the labor and cost involved in installing external steam jackets or steam tracer tubes. Lightweight lengths of Unitrace can be joined by flanged connections, or by welding, as illustrated. Where valves and fittings are incorporated in the product line, the steam can be carried around the fittings by a jumper line.

ALCOA Unitrace has aluminum's natural corrosion resistance, making it well adapted for transferring molten sulfur, ammonium nitrate solutions, glacial acetic acid, fatty acids, naphthalene, phthalic anhydride, urea, wax, tar products, syrups, and numerous other products which must remain in liquid state during transfer.

*Registered Trademarks of Aluminum Company of America

Unitrace is now available in standard pipe diameters from 1 in. through 8 in. Special cast Unitrace flanges, trace-caps, elbows and adapter flanges of ALCOA A356-T7 alloy make possible complete Unitrace piping systems.

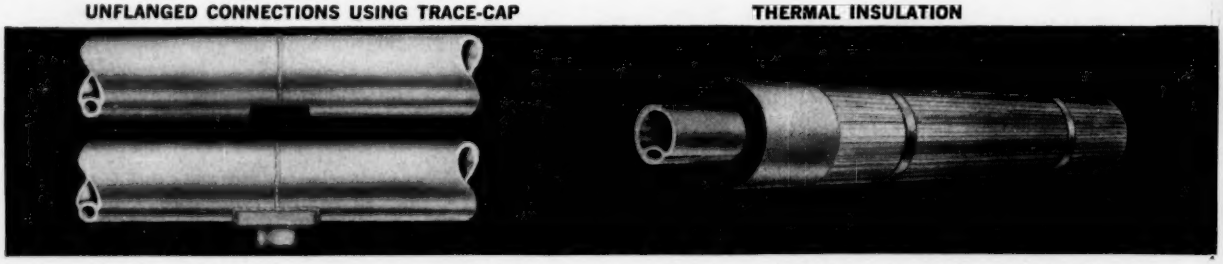
ALCOA engineers have worked closely with all segments of the process industries for over 40 years and can help you specify the aluminum alloy tubular products and equipment best suited for your particular process applications. ALCOA's unparalleled experience in this field is available to you for the asking. Write to the address below, stating your requirements as specifically as possible. ALCOA's development engineers will welcome the opportunity to work with you on your problems.

You also can take advantage of the wide selection of free ALCOA literature on aluminum for Unitrace and other process applications. Simply check the booklets you want on the coupon and mail to the address indicated. ALCOA will forward you the material promptly and without obligation.

During 1959, ALCOA will conduct engineering conferences in a number of major cities on process industries applications of aluminum. Contact your nearest ALCOA sales office for full particulars and dates.

UNFLANGED CONNECTIONS USING TRACE-CAP

THERMAL INSULATION



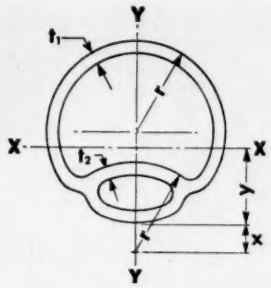
Where flanging is not required, sections of Unitrace can be joined easily and inexpensively by employing trace-cap. This is done by cutting back the trace line about an inch on the two sections of Unitrace to be joined. The product line then can be joined with a circumferential weld using 4043 weld wire. The trace-cap is then welded over the cut-away section to seal off the steam trace section of the Unitrace.

Alcoa Unitrace is designed to accommodate standard preformed pipe insulation. Boro-silicate glass wools or foams, or calcium silicate types are preferred. No protection of the aluminum surface is needed with these insulations. If cork, hair felt, asbestos cement or mineral wool is used, the aluminum surface should be coated with Aluminum Metal-and-Masonry Paint.

Temp. °F	Pressure psi	1 in.	1½ in.	2 in.	3 in.	4 in.	6 in.	8 in.
Up to 100°F	Bursting Pressure of Product Line	2980	2265	1925	1425	1210	1210	1085
	*Pressure Differential	2240	1700	1445	1070	910	910	815
	Bursting Pressure of Trace Line	2980	2265	1925	1425	1210	1210	1085
200°F	Bursting Pressure of Product Line	2800	2130	1810	1340	1140	1140	1020
	*Pressure Differential	2100	1600	1360	1005	855	855	765
	Bursting Pressure of Trace Line	2800	2130	1810	1340	1140	1140	1020
300°F	Bursting Pressure of Product Line	2530	1920	1630	1210	1030	1030	925
	*Pressure Differential	1860	1410	1200	900	755	755	675
	Bursting Pressure of Trace Line	2530	1920	1630	1210	1030	1030	925
400°F	Bursting Pressure of Product Line	1340	1020	865	650	545	545	490
	*Pressure Differential	670	510	435	320	275	275	245
	Bursting Pressure of Trace Line	1340	1020	865	650	545	545	490

*The pressure in the product line should not exceed the pressure in the trace by more than this amount.

Note: Bursting pressure data based on tests with welded Unitrace flanges and minimum mechanical properties.



	Unitrace Sizes	1 in.	1½ in.	2 in.	3 in.	4 in.	6 in.	8 in.
Axis XX	Moment of Inertia (I) in.⁴	.09	.34	.72	2.71	6.52	31.82	81.82
	Radius of Gyration (R) in.	.37	.58	.72	1.09	1.42	2.12	2.78
	Section Modulus (S) in.³	.13	.34	.56	1.42	2.65	8.73	17.22
Axis YY	Moment of Inertia (I) in.⁴	.09	.33	.70	2.65	6.36	29.72	76.70
	Radius of Gyration (R) in.	.37	.57	.71	1.08	1.40	2.05	2.69
	Section Modulus (S) in.³	.14	.34	.59	1.52	2.83	8.97	17.79

Sizes	1 in.	1½ in.	2 in.	3 in.	4 in.	6 in.	8 in.
r	.657	.950	1.187	1.750	2.250	3.312	4.312
t_1	.133	.145	.154	.170	.187	.280	.322
t_2	.145	.163	.174	.185	.200	.307	.354
x	.133	.344	.406	.625	.813	1.500	2.000
y	.61	.87	1.08	1.59	2.03	2.98	3.87

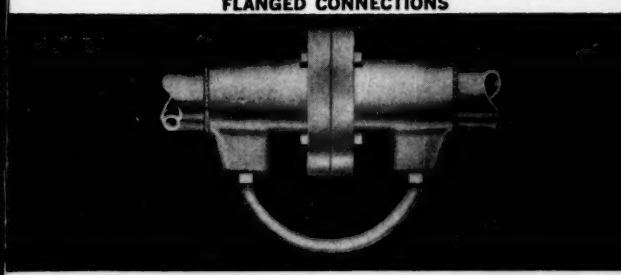
Unitrace Sizes	1 in.	1½ in.	2 in.	3 in.	4 in.	6 in.	8 in.
Product Area (in.²)	.64	1.68	2.72	6.38	10.84	24.64	42.79
Trace Area (in.²)	.10	.16	.35	.98	1.86	2.85	5.12
Metal Area (in.²)	.65	1.03	1.39	2.28	3.24	7.05	10.60
Weight (lb/ft)	.77	1.22	1.66	2.71	3.85	8.38	12.60
*Min. Bend Radii (in.)	5	8	10½	17	24	36	48
Wetted Perimeter							
Product	3.35	4.92	6.31	9.68	12.72	18.63	24.75
Trace	1.49	1.71	2.40	4.13	5.32	6.75	9.63
Fitting Weights (lb)							
Trace-Caps	.102	.126	.240	.464	.674	1.67	2.92
Elbows	.706	1.347	2.111	5.244	9.649	27.76	52.51
Impingement Plates	.024	.039	.057	.101	.162	.22	.34
Flanges	1.186	1.919	2.851	5.515	7.762	12.93	18.62

	1-2 in.	1½-2½ in.	2-3 in.	3-4 in.	4-6 in.	6-8 in.
Adapter Flanges	2.419	3.816	4.774	7.216	11.106	19.23

*Unitrace may be bent in any direction to these radii provided reasonable tooling is employed.

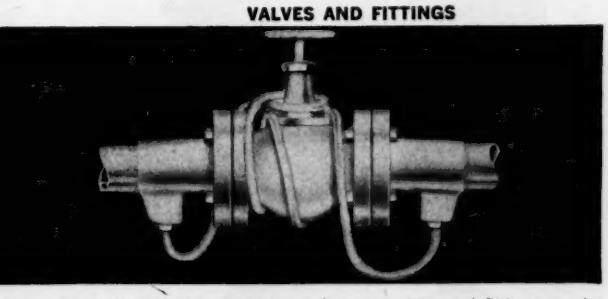
Average coefficient of thermal expansion (per °F)	−58 to +68°F	68 to 212°F	68 to 392°F	68 to 572°F
	12.1×10^{-6}	13.0×10^{-6}	13.6×10^{-6}	14.2×10^{-6}

FLANGED CONNECTIONS

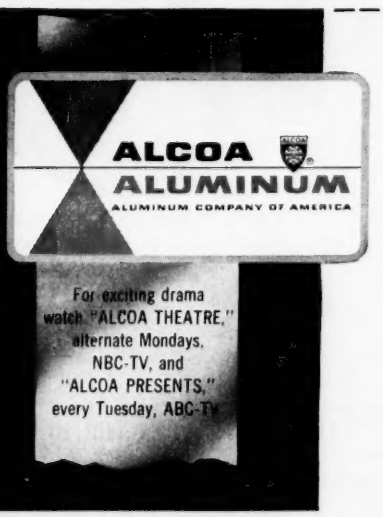


Special cast Unitrace flanges are available in alloy A356-T7. Bolt holes mate with standard 150-lb ASA pipe flanges for easy joining to other piping and equipment. For joining, the Unitrace trace line is cut back a short distance. The Unitrace is inserted into the flange and welded at the front face and neck of the flange using 4043 weld wire. Adapter flanges are available for joining different sizes of Unitrace.

VALVES AND FITTINGS



Through use of Alcoa Unitrace flanges, valves and fittings can be incorporated into a Unitrace system. Tapped openings are provided in the steam chamber of Alcoa Unitrace flanges to facilitate attachment of jumper connections to traced valves and fittings. Alcoa offers Unitrace elbows with a 3x centerline radius. Several valve manufacturers offer steam-traced valves of aluminum.



Aluminum Company of America
871-H Alcoa Building, Pittsburgh 19, Pa.

Please send me the following literature on Alcoa Unitrace and other aluminum piping for the processing industry.

- ☐ 10186 Alcoa Aluminum Heat Exchanger Tubes
- ☐ 20437 Aluminum Alloy Heat Exchangers in the Process Industries
- ☐ 10460 Process Industries Applications of Alcoa Aluminum
- ☐ 10415 Welding Alcoa Aluminum
- ☐ 34-10418 Alcoa Unitrace: Combines Piping and Tracing in One Unit

Name_____

Company_____

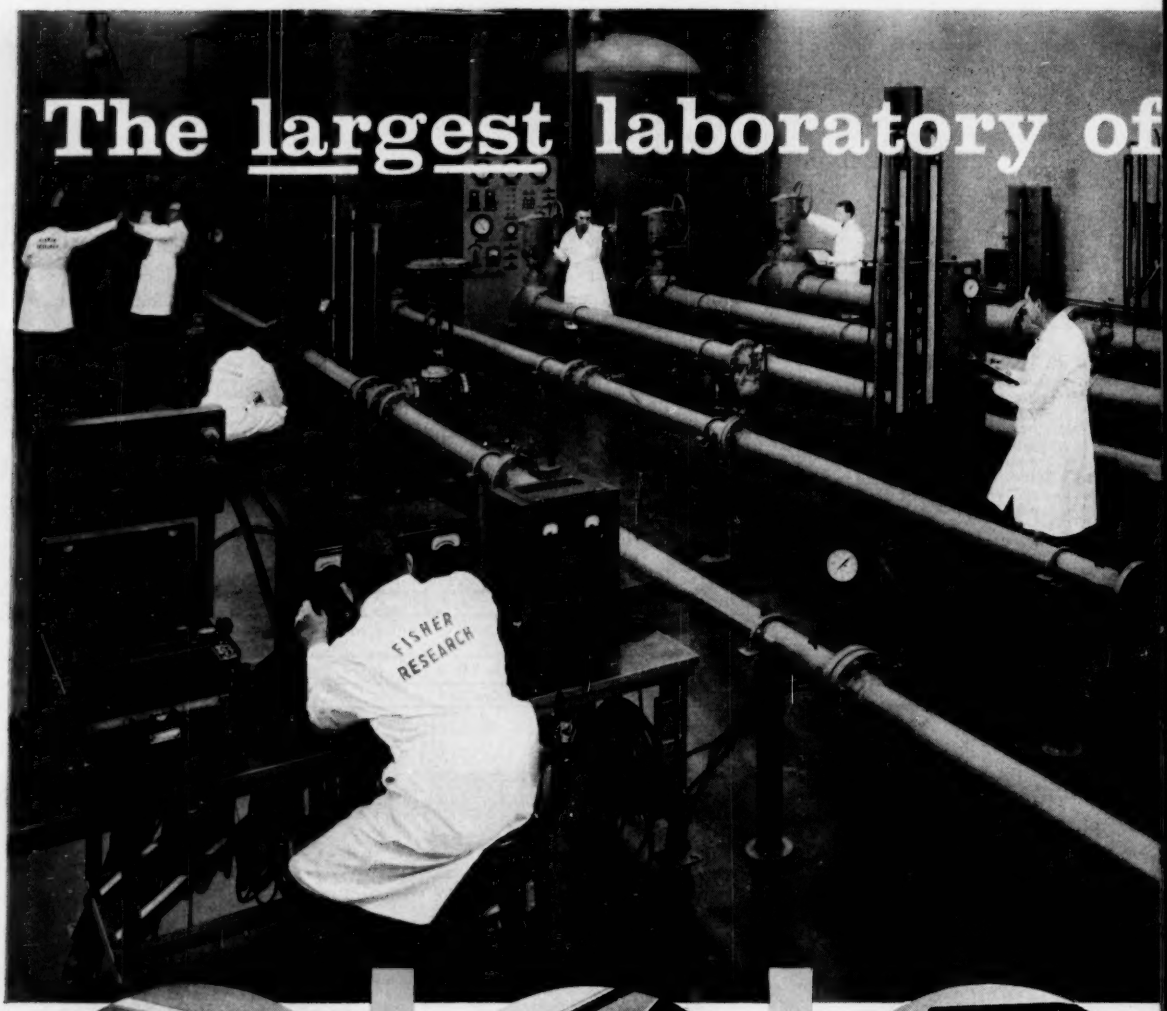
Title_____

Address_____

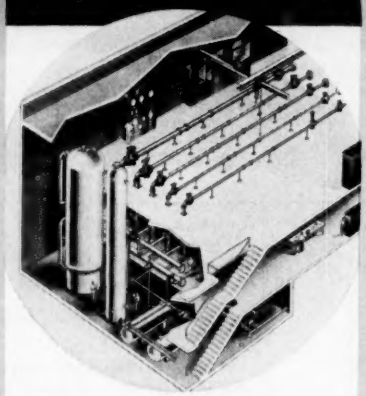
City_____

State_____

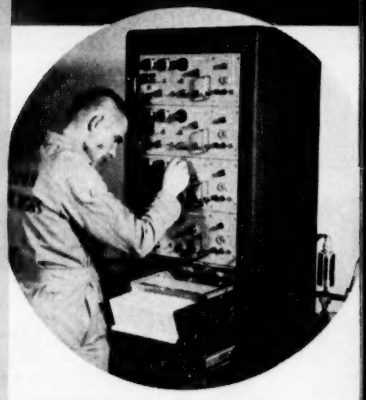
The largest laboratory of



Flowmeters and manometers are just two types of precision equipment used for accurate measurement in this unique laboratory.

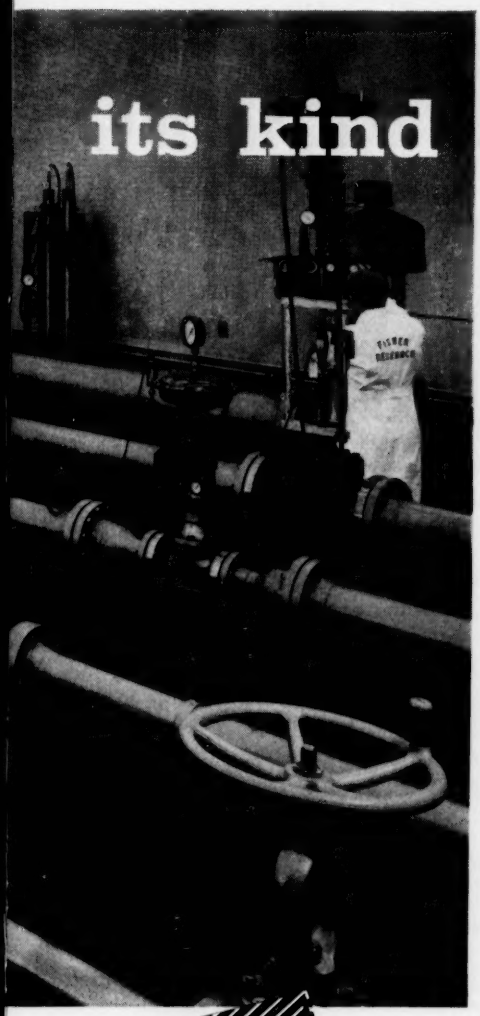


Three full stories are devoted to testing and proving the quality of all Fisher equipment.



A Fisher engineer obtaining frequency response data of Fisher equipment under test on an oscillograph.

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD... CHANCES ARE IT'S CONTROLLED BY...



its kind in the world

where research engineers develop and perfect the quality of Fisher products

THIS is a remarkable facility. It's the nerve center of a 3-story laboratory built to duplicate every conceivable field condition under which any Fisher product might operate. There's no other like it, anywhere. The engineers shown are keeping keen observation on the operating characteristics of such Fisher equipment as pressure regulators, liquid level controls, diaphragm control valves . . . plus many other types. There are literally hundreds of these complex and abnormally rigid tests which Fisher controls are subjected to before they are released to the user.

QUICK FACTS ABOUT THE FISHER LABORATORY

- It is equipped with vessels capable of storage pressures up to 2500 psig. These vessels discharge into five flow metering lines ranging in size from 4 inches to 12 inches.
- It is possible to test with either air or water at 400 psig pressure. One 4-inch line is capable of 2500 psig pressure for air or water testing.
- All flows are metered with orifice plates and differential manometers. Liquid flows can be metered up to 6000 GPM and gas flows up to 7,000,000 SCFH.
- Actual flow test curves are recorded on each Fisher valve design. This gives a visual record of the operating characteristics of each piece of Fisher equipment and proves that its performance in the line will precisely match published data.
- It is an approved laboratory for determining official ASME capacity ratings on safety and relief valves used on unfired pressure vessels.

The end result of these combined facilities and constant vigilance is the building and maintenance of user confidence . . . so that when an instrument man says "put a Fisher in the line" he knows that it will perform as promised and guaranteed.

Send for Bulletin AL-8

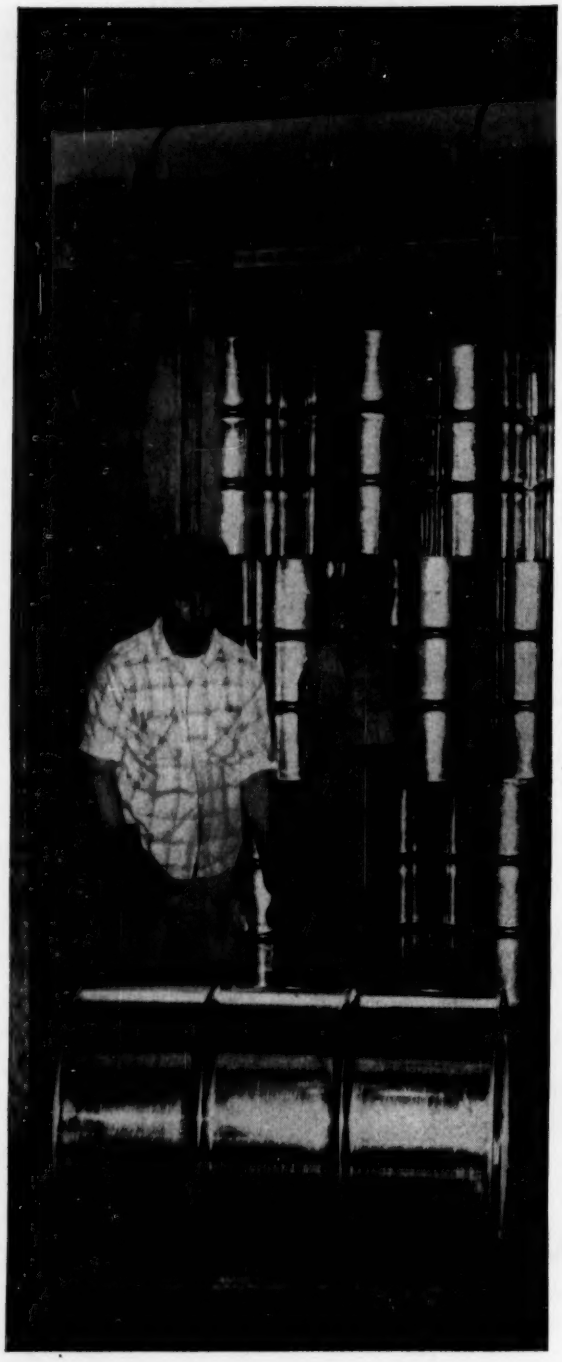
This comprehensive booklet contains valve sizing and capacity charts obtained from thousands of actual laboratory flow tests for all Fisher body types and inner valve styles.

FISHER GOVERNOR COMPANY
Marshalltown, Iowa / Woodstock, Ontario / London, England
BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIPMENT CO., CORAOPOLIS, PENNSYLVANIA

FISHER® Controls
SINCE 1880

REPUBLIC STEEL DRUMS

...are strong and safe to protect their contents!



Republic Steel Drums are rugged on the outside, chemically clean on the inside, for protection of their contents under all kinds of conditions. They are available in a wide range of types and sizes, in both light and heavy gage classifications, to provide a complete service to the chemical industry.

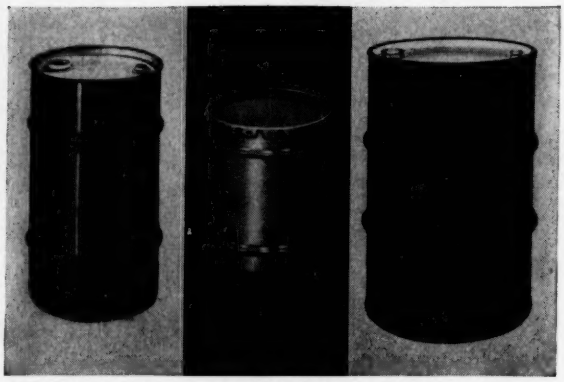
Light Gage Class I.C.C.—17E, 17H, 17C, 6J; Republic offers either tight-end or full-removable head drums as specified. Drum bodies and heads can be decorated to order. High-bake lacquer linings are available, or drums can be hot dip galvanized or hot dip tinned to handle difficult-to-hold materials.

Heavy Gage Class I.C.C.—5, 5A, 5B, 5C, 17F, and certain I.C.C.—6 Series. Drums are available in 55-, 30-, and 20-gallon capacities, from 16- to 12-gage in hot rolled carbon steel, depending on specification and service. As with the light gage service, hot dip galvanizing and hot dip tinning can be provided. In addition, Republic offers containers made of ENDURO® Stainless Steel for the ultimate in long-lasting, trouble-free, corrosion-resistant performance.

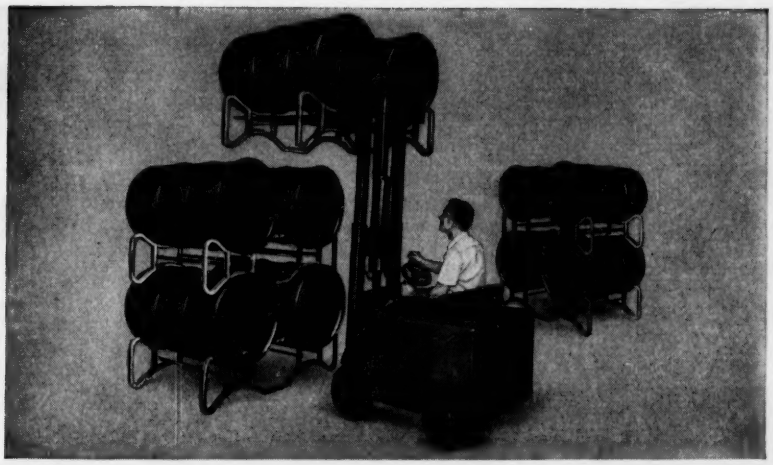
Republic also produces a full line of Steel Packages from 3½- to 20-gallon capacities. Gages range from 26 to 20 in plain steel. Decoration and special high bake linings can be applied to meet individual requirements.

Act now to obtain full information on Republic Steel Drums, and how they can protect your materials. Send coupon at lower right for detailed literature.

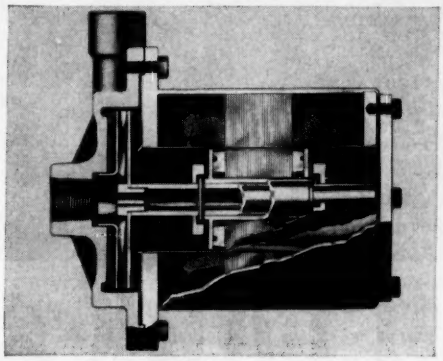
A FEW AVAILABLE TYPES



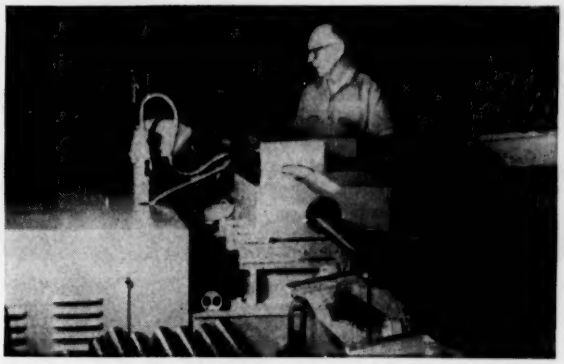
Universal Standard 15- or 16-Gallon Oil Drum | Republic 10-Gallon Lug Cover Drum | I.C.C. 5, 5B, and 17F Heavy Duty Drum



PORTABLE DRUM RACKS shown are exclusive with Republic, and are available at low cost. Each will accommodate two loaded 55-gallon drums, permitting stacking to any practical height to save valuable floor space. Republic Portable Drum Racks are shipped knocked down, with fasteners for quick and easy assembly. Send coupon for details.



REPUBLIC TITANIUM CAN ADD YEARS TO EQUIPMENT LIFE. Maximum corrosion-resistance plus an exceptionally high strength-to-weight ratio are major reasons for its use in this seal-less, leak-proof centrifugal pump made by Chempump Corporation, Philadelphia, Pennsylvania. The pump handles such corrosive liquids as chlorine dioxide. All wetted parts are made from Titanium. Chempump's exclusive design makes it possible and *economical* to use Titanium for these vital parts. Mail coupon today for more facts on Republic Titanium.



POSITIVE MEASUREMENT OF QUALITY can now assure you of the dependability of Republic ELECTRUNITE® Heat Exchanger Tubes. Now you can specify FARROW-TEST®, a production method of electronic testing, as an alternative to other less positive tests . . . *at no extra cost!* ELECTRUNITE Carbon and Stainless Heat Exchanger Tubes are produced from highest quality flat-rolled steel, electronically welded by an exclusive process that unites the tube under pressure without the addition of foreign metal. This process assures uniformity, strength, ductility, concentricity, and other physical properties to meet critical performance specifications. For additional facts on Republic ELECTRUNITE Heat Exchanger Tubes, mail coupon now.

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Please send more information on:
☐ Steel Drums and Packages ☐ Portable Drum Racks
☐ Titanium ELECTRUNITE Heat Exchanger Tubes
☐ Carbon ☐ Stainless Steel

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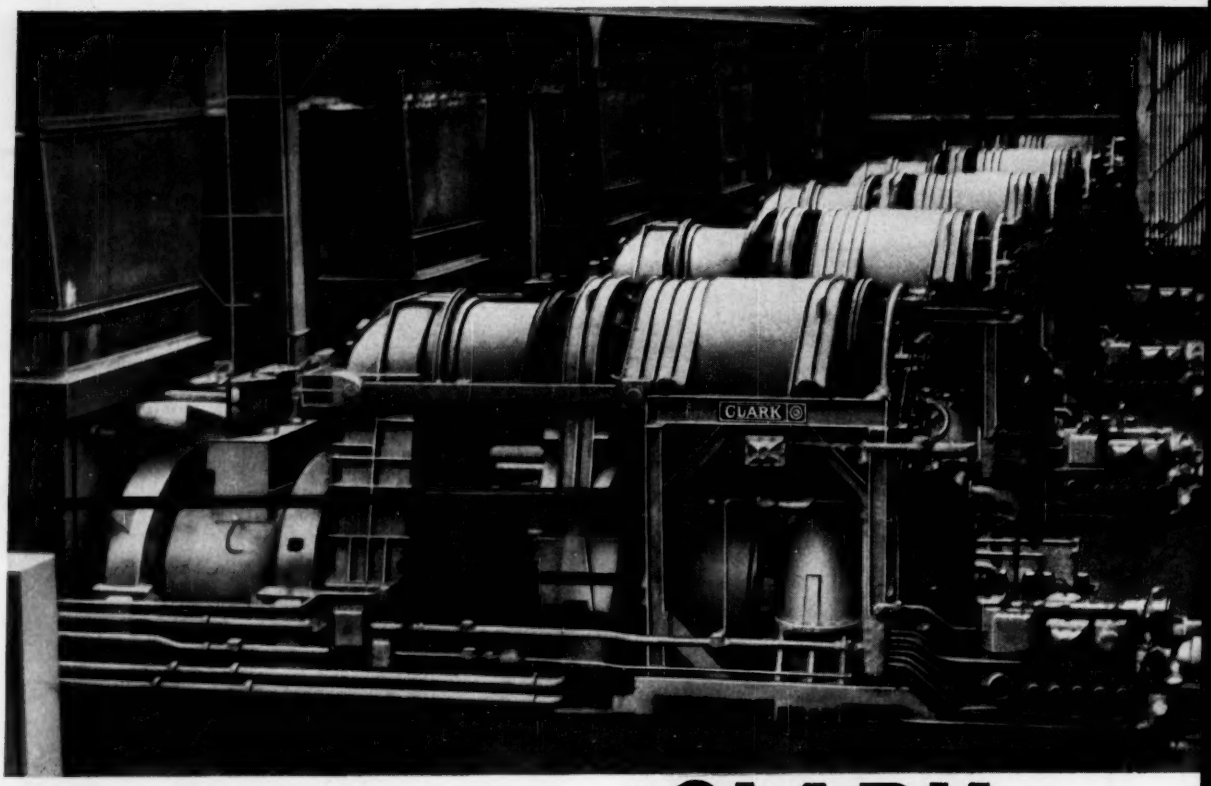
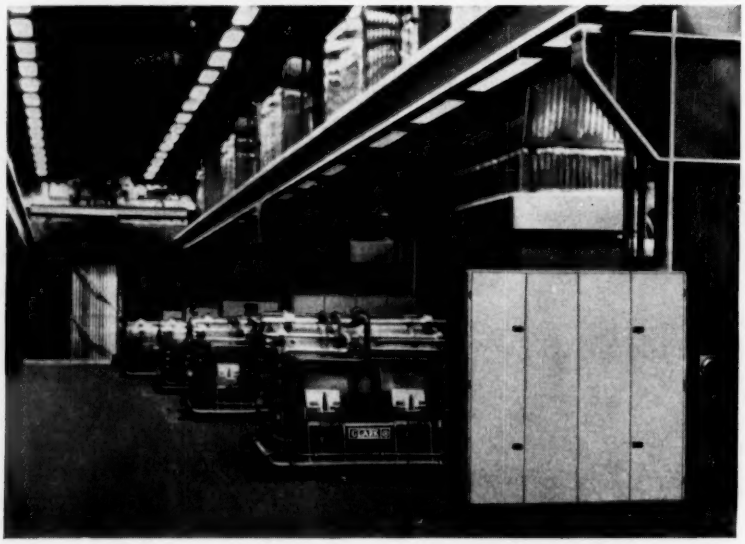
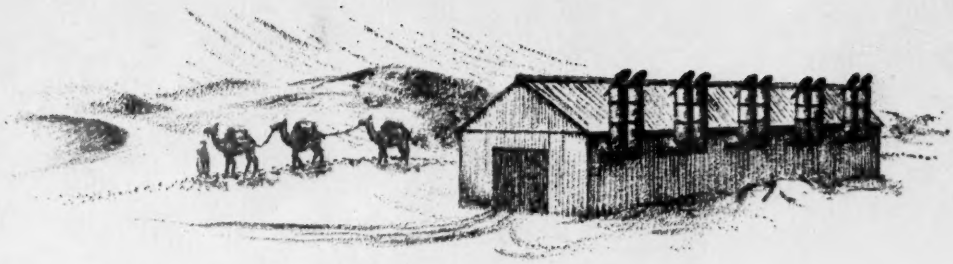
City_____ Zone____ State_____



Five Clark Model 305 Gas Turbines drive Clark vertically-split centrifugal compressors operating in series. The station is highly automated with only two operators required per shift.

CLARK Gas 210,000,000





In the Arabian Desert...

At 'Ain Dar, Saudi Arabia, five Clark Model 305 Gas Turbines are driving Clark Vertically-Split Centrifugal Compressors for the gas injection program of the Arabian American Oil Company.

Surrounded on all sides by the torrid Arabian desert, the turbines and compressors are installed in a pressurized building to keep out wind driven sand. Available fuel for the turbines is sour gas while ambient temperatures soar to unusually high levels.

The 'Ain Dar injection plant draws gas from five gas-oil separator plants at a pressure of 125 psig, compressing it to 2100 psig for injection. Any four of the five series connected, turbine-driven Clark compressors can provide the necessary pressure ratio for injection. Maximum flexibility is achieved by the use of dual shaft gas turbines. An additional Model 302 turbine drives a 5600 KW generator to power the gas-oil separator plants.

Turbines Power Aramco SCFD Gas Injection Plant

Proved dependability, minimum maintenance and the low installation costs experienced by other users of Clark gas turbines were important factors in selecting the turbines and compressors for the 'Ain Dar plant.

The fact that some of the Clark turbines and compressors could be delivered from the Olean plant and the balance from Italy, was also of prime importance to Aramco.

Clark 305 and 302 gas turbines have a standard rating of 8700-9300 bhp. 1220 bhp. models are also available. Consult your Clark representative for your next gas turbine or centrifugal compressor project or write for descriptive literature.

CLARK

CLARK BROS. CO.
OLEAN, N. Y.
One of the Dresser Industries

COMPRESSORS • GAS TURBINES

completely corrosion-proof

- **Chemically inert from end to end —** non-contaminating and universally useful
- **Flanged ends —** liner covers full gasket face for continuous protection
- **Unaffected by corrosive fluids —** special compound of Teflon developed for maximum life

Here's a hose exclusive on two counts. (1) It has *flanged ends* – the first fluorocarbon hose to have them. (2) It has the patented Fluoroflex®-T tube.

Tube extends to cover the full gasket face of the flange, forming a continuous and integral assembly of hose and flanges. Fluid cannot contact metal. Eliminates need for costly alloy fittings.

Cleaning problems are simplified, too. The smooth, continuous bore prevents entrapment of materials.

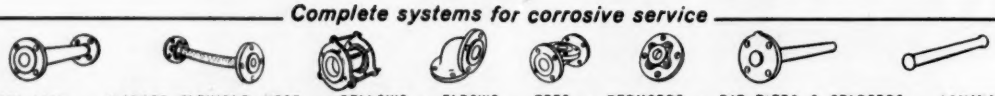
A special, high-density, non-porous compound of virgin Teflon, Fluoroflex-T is completely inert to virtually all known chemical and corrosive solutions, solvents and gases to 500° F. Write Dept. 299 for more data.

RESISTOFLEX CORPORATION, Roseland, N.J.
Other Plants: Burbank, Calif.; Dallas, Tex.

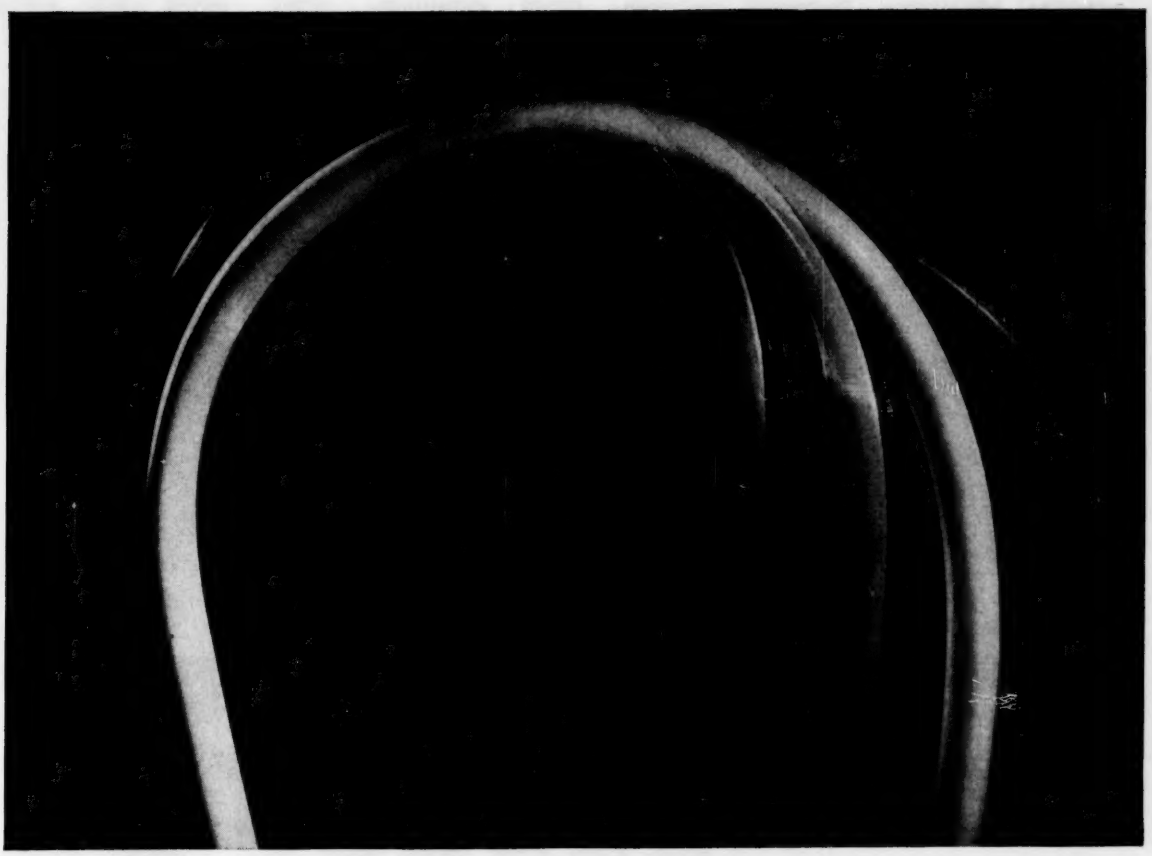
® Fluoroflex is a Resistoflex trademark, reg., U.S. pat. off.
® Teflon is DuPont's trademark for TFE fluorocarbon resins

RESISTOFLEX

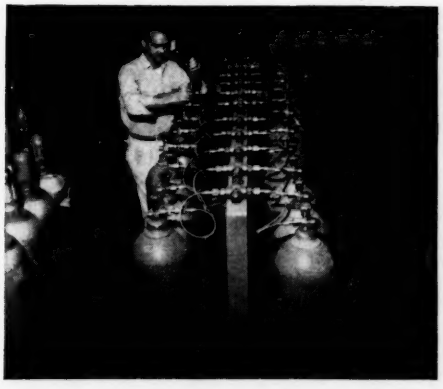
Complete systems for corrosive service



LINED STEEL PIPE • FLANGED FLEXIBLE HOSE • BELLOWS • ELBOWS • TEES • REDUCERS • DIP PIPES & SPARGERS • LAMINATED PIPE



Meet your needs for LONG FLEX LIFE with hose of Du Pont TFE resins



At this plant, metal "pigtails" used in loading N_2O and CO_2 lasted only 3 months. Rubber-hose life was even shorter. Hose lined with TEFLON TFE resin has been in use one year without failure. It withstands the flexing and impulsing, even at their 0°F. loading temperatures.

TEFLON is Du Pont's registered trademark for its fluorocarbon resins, including the TFE (tetrafluoroethylene) resins discussed herein.

If continuous flexing, twisting, impulsing or vibration threaten the service life of hose in your processes, consider the advantages offered by hose lined with TEFLON TFE-fluorocarbon resins. Tough and flexible, this hose provides exceptional durability under constant torque, vibration and flexing. TFE resins are used for continuous service from cryogenic temperatures to 500°F.; they are unaffected by virtually all chemicals; and their "waxy" surface reduces contamination and hold-up problems to a minimum.

This unique combination of properties makes hose of TFE resins ideal for the toughest service conditions encountered in the chemical and petrochemical industries. And now, new constructions, especially for industrial applications, include fiber reinforcements, elastomeric coverings, convoluted tubing of TEFLON for greater flexibility, and a variety of industrial couplings. Consult your dealer or write to E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 108, Du Pont Building, Wilmington 98, Delaware.

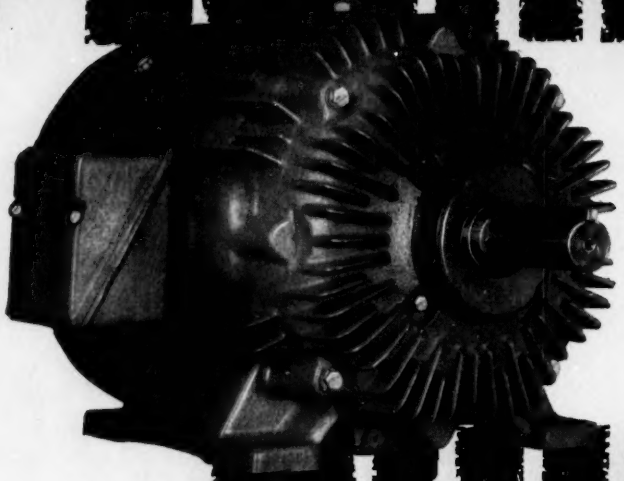
In Canada: Du Pont of Canada Ltd., P.O. Box 660, Montreal, Quebec.

DU PONT REG. U.S. PAT. OFF. **TEFLON®**

TFE-FLUOROCARBON RESINS

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

SPECIALLY BUILT

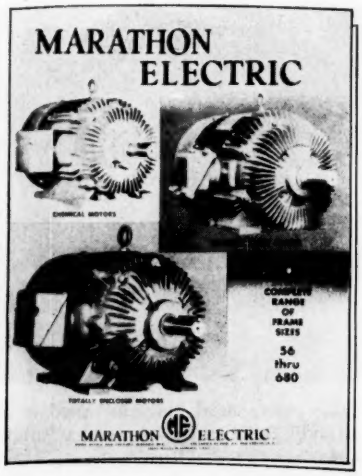


for all atmospheric and hazardous conditions

Depend on *ME* for designs that assure safe, long motor life despite corrosive elements in and about chemical plants. From a complete range of chemical and explosion-proof motors, Marathon quickly supplies your needs from a single motor to power-fitting an entire plant.

Free detailed information.

Marathon chemical motors incorporate the most recent features and improvements based on almost 50 years of motor building. For complete factual information, write for your copy of bulletin SB-185. *Marathon Electric Manufacturing Corporation, Wausau, Wisconsin.*



Motors and generators—that's our business!

Motors from 1/20 HP to 3500 HP
Generators from 1/2 KW to 2500 KW

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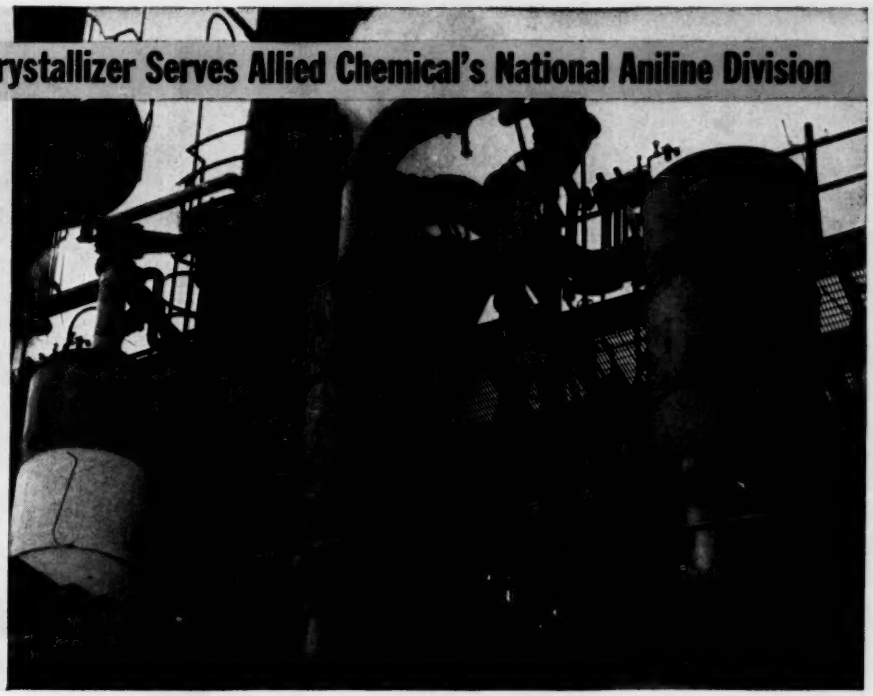
Another CB&I Crystallizer Serves Allied Chemical's National Aniline Division



CB&I crystallizer system produces high purity, highly uniform adipic acid crystals for use in synthetic fibers at the Hopewell, Va. plant of National Aniline Division. Is one of several CB&I-built systems used by the company.

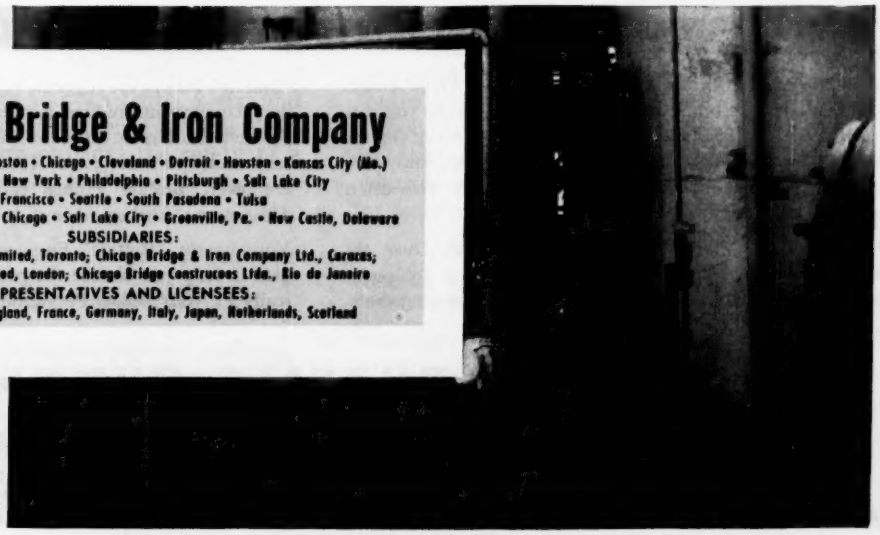
Three-stage system produces high purity adipic acid crystals

The chemical industry demands—and gets—uniform, high purity adipic acid crystals from the Allied Chemical's National Aniline Division plant at Hopewell, Virginia.

Here, a CB&I-built three-stage crystallization system *twice* re-dissolves the crystalline crop to remove impurities. Then the system's third effect produces the final *quality* crystals required as raw material for the chemical industry.

Fabricated of type 304L stainless steel to resist corrosion and to prevent iron contamination, the crystallizer system has been in continuous service for three years.

Dependable, profitable performance such as this is one reason so many CB&I crystallizer-evaporator customers—become repeat customers for CB&I processing vessels, which include: Crystallizers • Evaporators • Flash Evaporators • Condensers • Heat Transfer Equipment • Digesters • Vaporizers • Vacuum Dryers • Boiler Feed Water Equipment



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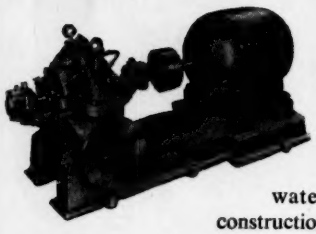
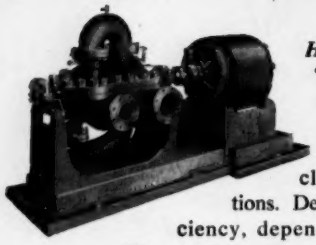
C-48-C

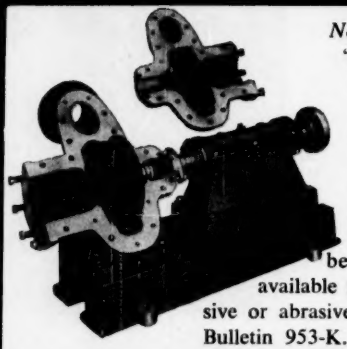
HOW MUCH WILL IT COST YOU



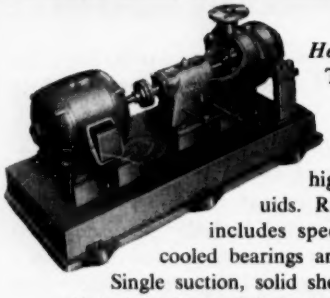
Clear Water Pumps: "Buffalo" Double Suction Pumps assure maximum efficiency in clear water service. Rugged construction provides long life with minimum maintenance. 10 to 14,000 gpm capacities. Write for Bulletin 955-R.



High Pressure Pumps: "Buffalo" Multi-Stage Pumps are ideal for boiler feed and other clear water applications. Designed for top efficiency, dependability, long life. These husky pumps operate against heads as high as 1500 ft., in capacities to 900 gpm. Write today for Bulletin 980-D.



Non-Clogging Pumps: "Buffalo" Diagonally Split-Shell Pumps are specially designed for moving high consistency liquids. Down-time, wear and wedging are reduced. Rubber-lined models are available for pumping corrosive or abrasive liquids. Write for Bulletin 953-K.



Heat Transfer Pumps: These special "Buffalo" pumps are engineered for handling high-temperature liquids. Rugged construction includes special alloys, water-cooled bearings and special packing. Single suction, solid shell design is highly efficient. Write for full details.

Chemical Liquid Pumps: These special "Buffalo" Pumps are engineered for severe service in handling most corrosive, abrasive or high consistency liquids. Ten special types are available in a variety of trim. Write for Bulletin 982-A.

NOT TO INSTALL "BUFFALO" PUMPS?

How "Buffalo" Pumps Can Save You Money Right Away: "Buffalo" offers a broad line of pumps. This means you can usually choose the right pump to fill almost every liquid-moving need. With "Buffalo" Pumps you pay only for the type, size and capacity required — no more. This often means substantially lower initial cost.

How "Buffalo" Pumps Can Save You Money Over the Years: "Buffalo" Pumps are engineered for peak hydraulic efficiency. This gives you consistently lower pumping costs. "Buffalo" Pumps are ruggedly built throughout. Extra heavy-duty components reduce maintenance costs over a longer productive life span. "Buffalo" Pumps are designed for quick, easy access to inner parts. Thus routine maintenance costs are lower. "Buffalo" Pumps feature parts interchangeability. This means further savings in reduced parts inventories.

Your nearby "Buffalo" Engineering Representative will be glad to help you choose the pumps that will most economically fill your needs. Phone him today, or write us direct.

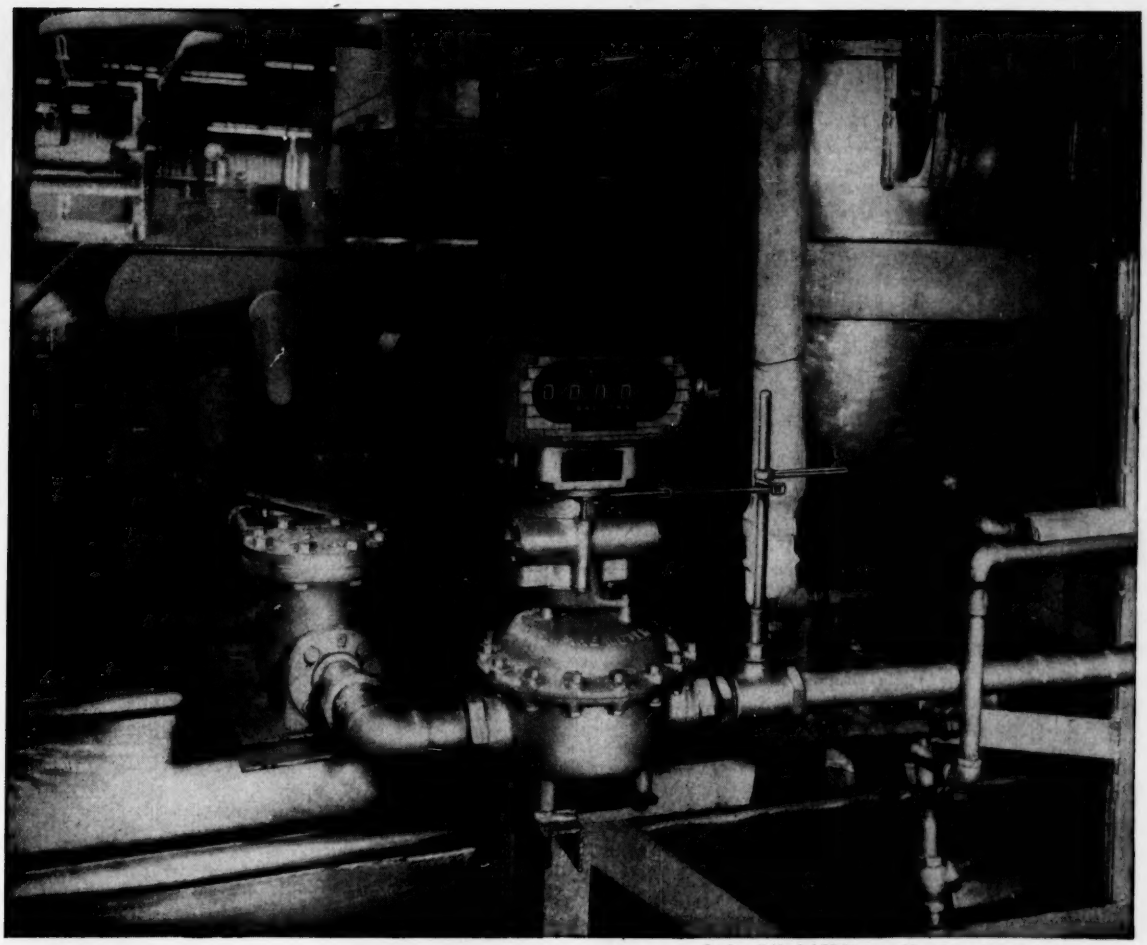
"Buffalo" PUMPS

BUFFALO PUMPS
Division of Buffalo Forge Co.
501 Broadway Buffalo, N. Y.

Canada Pumps, Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID



Rockwell Model ER Meter with automatic quantity control shut-off in food processing plant

Batch it, blend it, or just plain account for it!

IT'S GOOD BUSINESS TO METER ALL LIQUIDS

Wherever liquids are stored, mixed or used in plant operations, you can save time, money and improve efficiency with Rockwell industrial meters. With meters you can batch, blend and control formulas with precision. Handling volatile liquids, metering provides the safety of a closed piping system and guards against contamination.

Rockwell industrial meters are valuable accounting tools. Thousands use them for in-plant cost identification purposes, for inventory control—even to guard plant security.

You can measure most any piped liquid with Rockwell meters—oils, liquors, paints, chemical solutions—over 50 liquids in all. Use the coupon for full details.

CLIP COUPON—MAIL TODAY!

INDUSTRIAL METERS

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Gentlemen:

I am interested in measuring _____ (Name of Liquid)

Pipe Size _____ "

Working Pressure _____ psi Temperature _____ °F max.

Max. Flow Rate _____ gpm Min. Flow Rate _____ gpm

Your Name _____

Company _____

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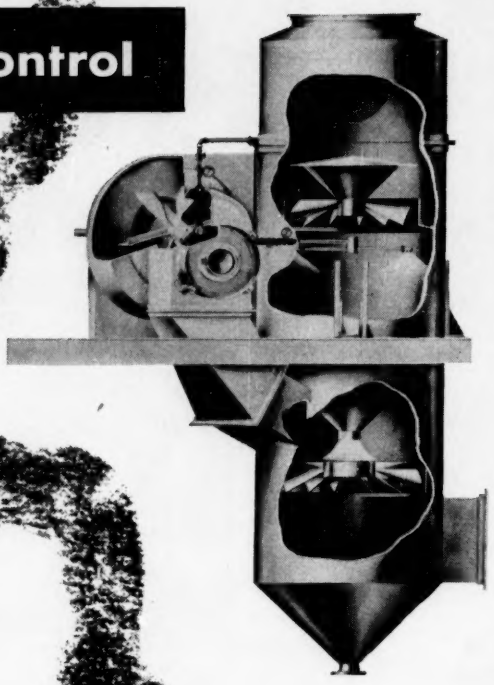
. . . in wet dust control



Patented

NEW DUCON DYNAMIC WASHERS

RECOVER DIFFICULT DUSTS EFFICIENTLY AND ECONOMICALLY

Ducon UW-4 Dynamic Wet Dust Collectors have added a new dimension in dust recovery. They have replaced, with outstanding success, many more costly and less effective dust collectors in the recovery of "difficult" materials, such as fine and abrasive dusts in kilns, rotary driers and other applications.

The UW-4 Washers are also ideal for high loading conditions where maximum efficiency is desired.

Ducon UW-4 washers offer other unique advantages, including constant air capacity, low water consumption and rugged construction. They are self-cleaning and fire and explosion proof.

For complete information write for Bulletin W-7456.

DUST CONTROL SYSTEMS AND EQUIPMENT — DUCON

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147 EAST SECOND STREET • MINEOLA, L. I., NEW YORK

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CYCLONES • CENTRIFUGAL WASH COLLECTORS • TUBULAR CLOTH FILTERS • DUST VALVES

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U.S.I. CHEMICAL NEWS

August ★ A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries ★ 1959

U.S.I. Names New Manager For Alcohol, Solvent Sales

Thomas R. Drinkwater has been named Manager of Industrial Alcohol and Solvents Sales for U.S.I., largest marketer of ethyl alcohol in the U.S. In his new position, Mr. Drinkwater succeeds Warren E. Johnson who has just been appointed Director of Chemical Sales.

T. R. Drinkwater

Mr. Drinkwater worked out of the company's Chicago Sales office until 1957 when he was made Assistant to the Manager of Alcohol and Chemical Sales, the position he was holding at the time of this new appointment.

Alcohol Aerosol Formulas Proposed for Gibberellin

Because the remarkable plant growth stimulant, gibberellin, has proven effective in dosages as low as 5-10 micrograms, aerosol dispensing has been suggested as a highly accurate, convenient and economical means of applying the material. Using a meter-type valve designed to release about 100 milligrams of formulation containing about 5 micrograms of stimulant, one 3-ounce aerosol container (2 ounce practical fill) could give more than 500 applications.

Gibberellin is said to lose its effectiveness gradually in water solutions, and consequently all formulas which have been suggested for the material have been nonaqueous. The following composition for packaging in glass has been proposed:

Gibberellin	0.00625 wt. %
Surfactant	0.200
S.D. Alcohol #40, anhyd.—q.s.	50.00
Propellant	50.00

This composition is among those recommended for packaging in lacquer-lined metal:

Gibberellin	0.00625 wt. %
Surfactant	0.2
S.D. Alcohol #40, anhyd.—q.s.	20.0
Propellant	80.0

Polyethylene Used for New Box-Type Mixer-Settler

The recently-reported development of a polyethylene, box-type, mixer-settler extractor — one of the first complex pieces of process equipment made almost entirely of polyethylene — points the way to still greater utilization of this tough, corrosion-resistant plastic as a material of construction for the Chemical Process Industries.

This piece of equipment was designed to handle corrosive chemicals used in the separation of materials by liquid-liquid extraction. It is a horizontal contactor in the form of a rectangular box about nine inches high. The box is divided into sections, each of which handles a stage in the extraction process. Each section contains a mixing chamber suspended in an antechamber, and a settling

MORE

U.S.I. Completes Million-Gallon Concrete Storage Tank for Phosphatic Fertilizer Solutions

One of Largest Ever Built for Phosphoric Acid Storage, Tank Holds 1½-Month's Plant Production, Is Designed To Increase Supply to Fertilizer Formulators

An innovation in phosphoric acid storage tanks — a reinforced concrete structure with a capacity of over a million gallons of phosphatic fertilizer solution — has just been completed at Tuscola, Illinois, site of U.S.I.'s wet-process phosphoric acid plant. This 100 ton-per-day plant serves fertilizer formulators in a 12-state area, and operates under the usual seasonal demand conditions of the agricultural chemicals field.

When the outsized storage tank goes into service this month, it will help smooth out the supply-demand curve both for U.S.I. and for the formulators served by the company. The tank will increase the plant's storage capacity by 1½ months' production, insuring formulators of a steady supply of raw material for their late winter and early spring compounding season.

The tank, built by the Preload Company, Inc. of New York, is one of the largest ever constructed for phosphoric acid storage, measuring 100 feet in diameter by 21½ feet high. It is made of reinforced concrete which was built up in place on a wire mesh form and pre-stressed in the construction. This is an innovation in tank design, since most phosphoric acid storage is in lined steel tanks.

Phosphoric as Fertilizer Material

While wet-process phosphoric acid has been an intermediate in triple superphosphate production for many years, its use as a raw material for mixed fertilizer generally dates back only to 1957. That use is growing rapidly for a number of reasons: It is the only commercial source of P_2O_5 in liquid form, which eliminates dusting and the problems of handling solids. It is by far the most highly acid

MORE

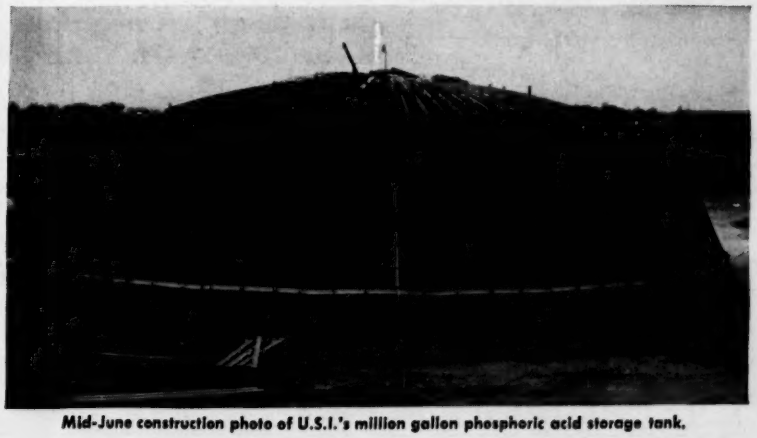
Sodium Borohydride Is Key To New Vinyl Foam Process

A new process for making vinyl foams has been developed, using sodium borohydride as the blowing agent. It is claimed that the new method yields a product with fine, uniform cell structure, low density and low compression set — using simple equipment and techniques. In addition, the process is said to permit the molding of small, intricate shapes unobtainable previously with vinyl foams.

Sodium borohydride, reacted with water in a mildly acid medium, gives sodium borate and hydrogen gas. The gas does the blowing and foaming. Control of the foam depends on the treatment of the borohydride before it is incorporated into the plastisol, and on the choice of activator promoting decomposition.

Heat and plasticizer viscosity are claimed to have no effect on cell size, eliminating the need for foam or heat stabilizers. Ultimate foam density depends only on borohydride concentration, which runs about 0.4%. Foams can be formed at room temperature or above. Setting, on the other hand, requires a 350°F temperature. When the plastisol expands at room temperature, cell structure is said to remain unchanged through the fuse and cool cycle.

Sodium borohydride is made by reacting hydrogen gas with metallic sodium dispersed in mineral oil to form sodium hydride, and then reacting this compound with methyl borate.



Mid-June construction photo of U.S.I.'s million gallon phosphoric acid storage tank.

August ★ **U.S.I. CHEMICAL NEWS** ★ 1959

CONTINUED

Storage Tank

source, and the most concentrated source (52-54%), of P_2O_5 available commercially. Finally, it can be a very economical source of P_2O_5, depending on location.

Because of these characteristics, wet-process phosphoric acid offers fertilizer formulators several important advantages: large quantities of ammonia can be neutralized, because of the high acidity characteristic. High analysis grades can be formulated because of the high concentration characteristic. And for granular goods, this raw material gives rugged granules, well suited to subsequent handling, without the addition of granulation aids.

Now, with the addition of large-scale storage facilities, the U.S.I. plant at Tuscola will be better able to handle the growing demand for this economical raw material by formulators in its market area.

CONTINUED

Polyethylene Extractor

chamber. Underflow and overflow ports connect the sections, for flow from stage to stage.

The box — and the partitions which separate the sections and the settling and antechambers within the sections — are made of polyethylene sheets. Each side of the box is one piece, as is the entire bottom. After assembly of box and partitions, all joints were reinforced and made water-tight by welding with molten polyethylene.

Mixing chambers are made from polyethylene cups, and polyethylene tubes welded to these cups act as inlets and outlets. Each mixing chamber contains an impeller assembly, consisting of saran mounting plate, stainless steel bearing, polyethylene-coated stainless steel shaft and a polyethylene impeller.

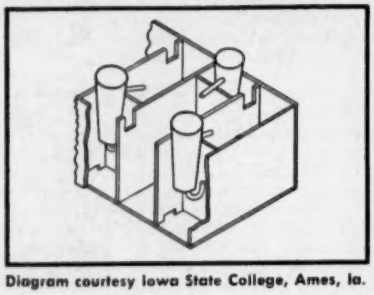
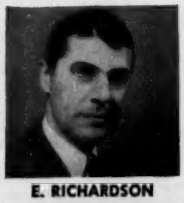


Diagram courtesy Iowa State College, Ames, Ia.

Three U.S.I. Sales Offices Get New Managers



E. RICHARDSON

Edward C. Richardson has been appointed U.S.I. Chicago Sales Division Manager, succeeding George H. Stanton who has been named Director of Field Sales for the company. Mr. Richardson has been Sales Division Manager for U.S.I.'s Boston office since 1950. He has been with the company's sales organization since 1940.

J. HALLOWELL

Jesse H. Hallowell succeeds Mr. Richardson as U.S.I. Boston Sales Division Manager. He has been with the company since 1953, first at the Tuscola, Ill. plant and most recently at the Chicago Sales office.

J. PUTNAM

John A. Putnam, formerly U.S.I. salesman in the Atlanta, Ga. area, has been promoted to Manager of U.S.I.'s Atlanta office.

ATTENTION: Users Of Industrial Alcohol

As of July 1, 1959, a carrier permit is no longer required to transport tax-free, specially denatured and undenatured alcohol, including tax-free distilled spirits. For many years the Internal Revenue Code, and regulations issued under it, required a permit for such transport. The Excise Tax Technical Changes Act of 1958 (Public Law 85-859) which went into effect July 1, 1959 revoked the statutory requirement for permits.

As of the close of business on June 30, the assistant regional commissioners automatically terminated all outstanding bonds covering carrier activities. No further action is required by carriers.

TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U.S.I.

Deodorant for industrial use, said to be odorless and to control residual odors without paralyzing olefactory nerves or masking, is now on market. Identified as quaternary ammonium compound, material has been used in hospitals, found to inhibit mold, mildew growth. **No. 1500**

Carbon wool — pure carbon in fiber form — can now be obtained in 6 standard types plus special grades. Said to have unusual combination of properties: low ash, color and sound absorption, heat resistance, inertness. **No. 1501**

Boron trifluoride neutron detectors, in wide range of sizes and several cathode materials, are now available. Detect slow neutrons by $B^{10}(n,\alpha)$ reaction. Can also detect fast neutrons by using moderators around detectors. **No. 1502**

Crystalline DL-glyceraldehyde 3-phosphate diethylacetal (GAP) now available in research quantities. Can be converted to DL-glyceraldehyde 3-phosphate, important in metabolism, respiration, fermentation, energy transfer. **No. 1503**

Booklet of conversion tables for metric and U.S. customary units of length, weight and volume can now be purchased. Contains conversions: mm-in., cm-ft., m-yd., g-avoir oz., kg-avoir lb., troy oz.-g, ml-fl. oz., l-US gal. **No. 1504**

New hydrazine flux for soldering electrical and electronic equipment is said to leave no rosin residue which is costly to remove; to be noncorrosive, insuring corrosion-free joints; to permit prefluxing. **No. 1505**

New adhesive for adhering paper labels to polyethylene containers has been developed. Claimed to form permanent flexible bond with all polyethylene surfaces and be fast-grabbing, with good shock resistance and aging qualities. **No. 1506**

Silicones and their uses are covered in new catalog. Uses described include: rubber products, cosmetics, polishes, electrical insulation, water repellents, textile finishes, lubricants, release and antifoam agents. **No. 1507**

Newly-formed abstracting service supplies, at a charge, technical abstracts on drugs, cosmetics, toiletries, foods, plastics, paints and advertising. Abstracts supplied on index cards. **No. 1508**

Industrial fatty acids — their chemistry, production, processing and applicatons — are covered in comprehensive new 250-page book which can be purchased. Important commercial derivatives are also discussed. **No. 1509**

PRODUCTS OF U.S.I.

HEAVY CHEMICALS

Phosphatic Fertilizer Solutions: wet process phosphoric acid.
Ammonia, Anhydrous: commercial & refrigeration. Tank cars or tank wagons.
Ammonium Nitrate, Nitric Acid, Nitrogen Fertilizer Solutions
Sulfuric Acid: all strengths, 60 Baume to 40% Oleum. Also Electrolytic grade to Federal specifications. Tank cars or tank wagons.
Caustic Soda, Chlorine
Sodium, Metallic: cast solid in tank cars, steel drums, pails; bricks in barrels, pails.
Sodium Peroxide

OTHER PRODUCTS

PETROTHENE® Polyethylene Resins
Pharmaceutical Products: DL-Methionine, N-Acetyl-DL-Methionine, Urethan USP, Riboflavin USP, Intermediates.
Alcohols: Ethyl (pure and all denatured formulas); Anhydrous and Regular Proprietary Denatured Alcohol Solvents SOLOX®, FILMEX®, ANSOL® M, ANSOL PR.
Organic Solvents and Intermediates: Normal Butyl Alcohol, Amyl Alcohol, Fusel Oil, Ethyl Acetate, Normal Butyl Acetate, Diethyl Carbonate, DIATOL®, Diethyl Oxalate, Ethyl Ether, Acetone, Acetoacetanilide, Acetoacet-Ortho-Chloranilide, Acetoacet-Ortho-Toluidide, Ethyl Acetoacetate, Ethyl Benzoylacetate, Ethyl Chloroformate, Ethylene, Ethyl Sodium Oxalacetate, Sodium Ethylate, Urethan U.S.P. (Ethyl Carbamate), Riboflavin U.S.P.
Animal Feed Products: Antibiotic Feed Supplements, Calcium Pantothenate, Choline Chloride, Special Liquid CURBAY, Menadione (Vitamin K_3), DL-Methionine, MOREA® Premix, Riboflavin Products, U.S.I. Permadry, Vitamin B_{12} Feed Supplements, Vitamin D_2.

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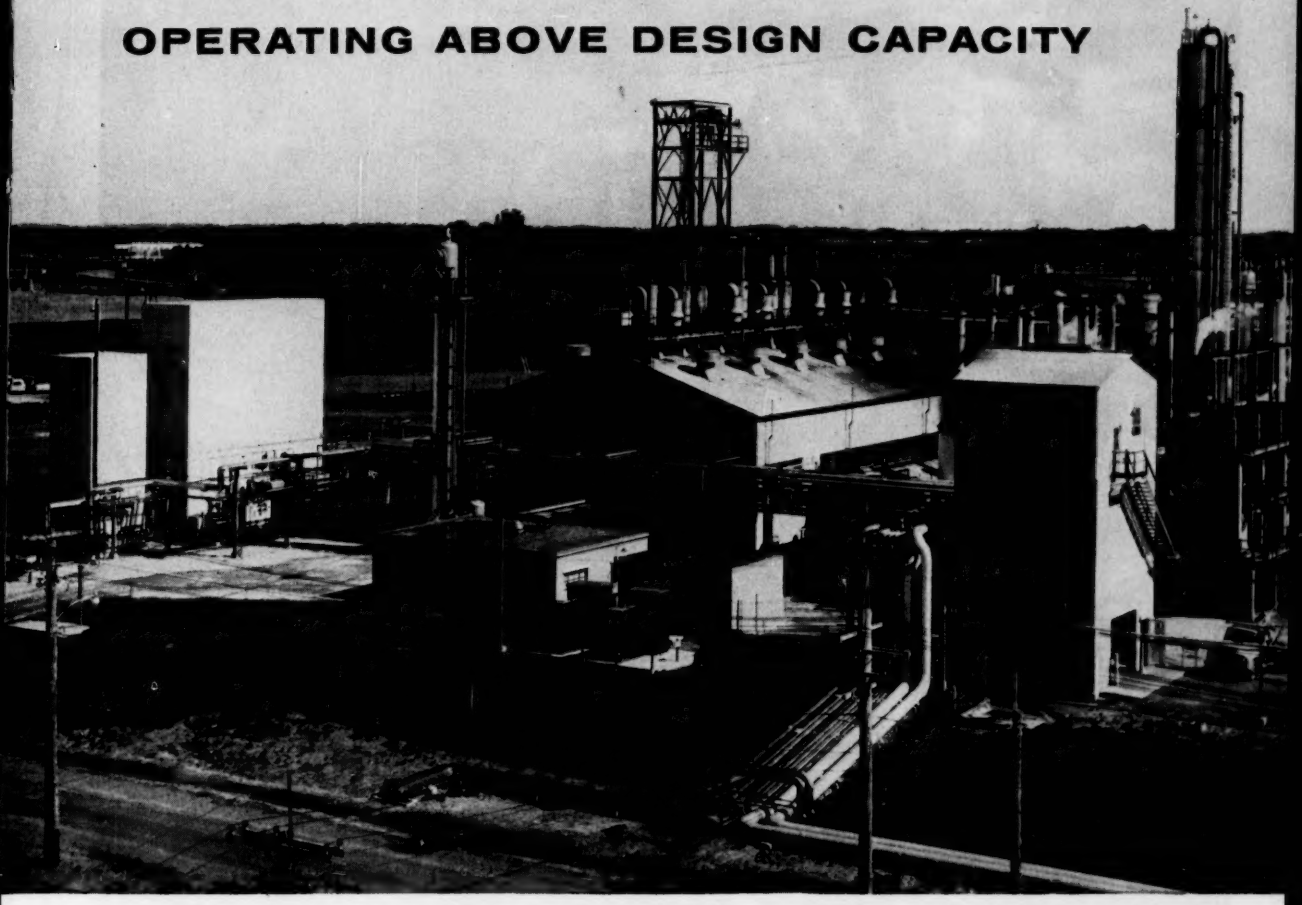
ST. PAUL AMMONIA PRODUCTS, INC. PLANT OPERATING ABOVE DESIGN CAPACITY



Ammonia Plant—Designed, Engineered and Constructed by Lummus—Feeds Natural Gas or Butane

The St. Paul Ammonia Products, Inc. plant at Pine Bend, Minnesota has been operating continuously at rates above the design capacity of 200 tons per day of ammonia. Lummus' policy of close cooperation with the client at every stage was followed at St. Paul Ammonia. Lummus' extensive experience in plant design and construction have been effectively combined with the experience in plant operation of St. Paul Ammonia's capable staff in order to achieve a successful project.

In addition to producing anhydrous ammonia and ammonium nitrate solutions for the fertilizer industry, St. Paul also produces anhydrous ammonia meeting industrial specifications.

The Texaco Synthesis Gas Generation Process is employed to produce hydrogen for ammonia synthesis. Natural gas direct from the pipeline is normally used as the raw material. However, during the cold Minnesota winters the supply of natural gas is subject to interruption when preference is given to household users. The plant is designed so that at these times butane is used as the raw material.

The large compressors are gas-engine driven and use natural gas fuel except during the winter months, when propane from storage tanks is employed. The Lummus design fits the plant to the needs of the area and permits this sort of flexible operation.

This plant utilizes a hot potassium carbonate system for removal of CO_2, which helps reduce production costs.

Lummus acted as general contractors for the entire project which includes ammonia synthesis, nitric acid, and ammonium nitrate solutions units, and offsite facilities including utilities, tankage and product shipping.

Lummus has experience in design and operation of ammonia plants utilizing natural gas, heavy fuel oil, butane, and waste chlorine cell hydrogen. Capacities of Lummus built ammonia plants range from 60 to 300 tons per day.

In the past 50 years, Lummus has built over 800 plants to produce petrochemicals, chemicals and petroleum products. If your company is planning facilities of this kind, discuss your plans with Lummus.

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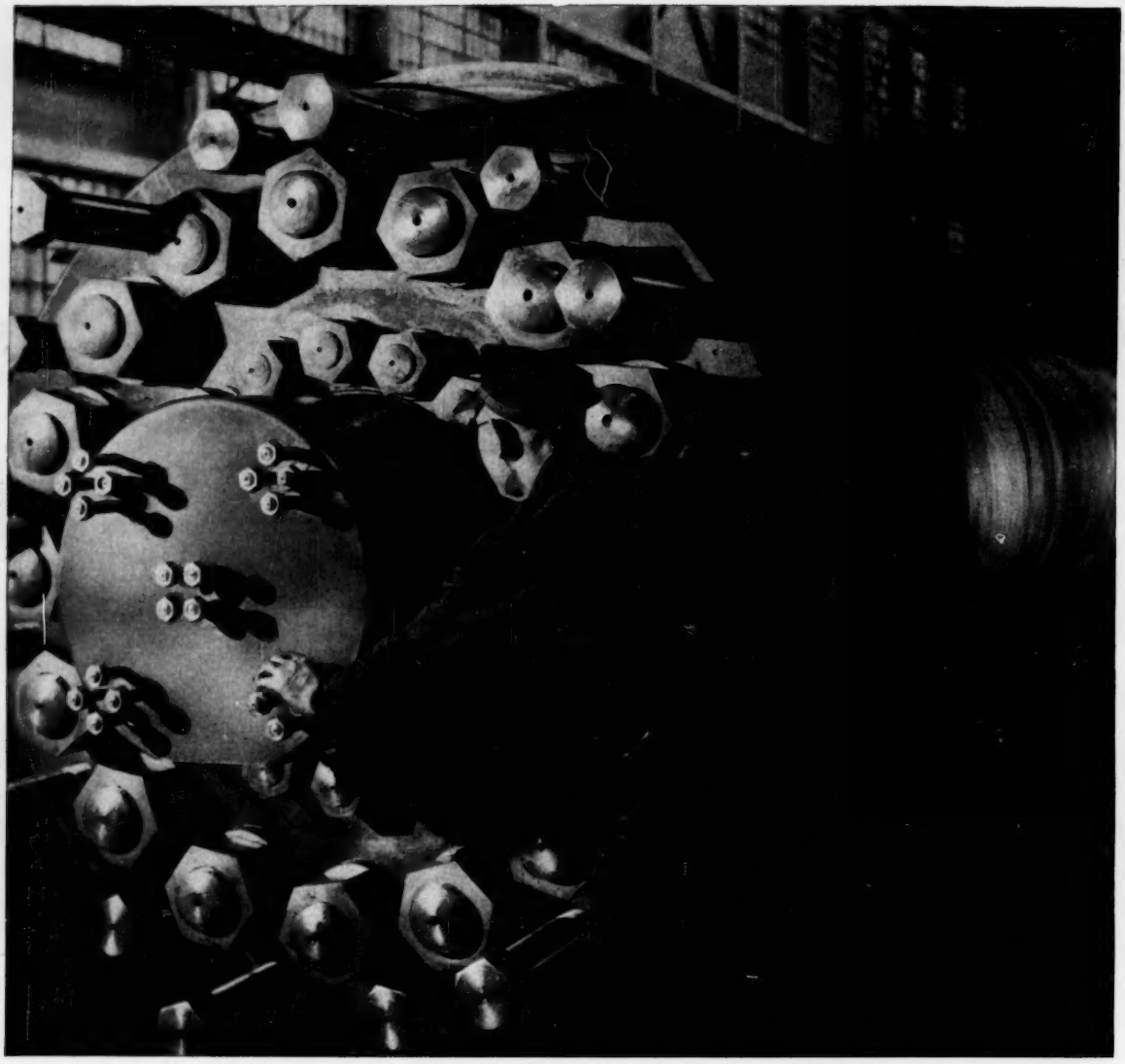


One of the Largest Bethlehem-Built Converters

This forged-steel converter is a real heavyweight, one of the biggest to emerge from the Bethlehem shops. It weighs approximately 150 tons; its inside body diameter is close to 4 ft. Those thick seamless walls are designed to withstand high pressures, and Bethlehem's forging process insures the necessary ruggedness and strength.

Vessels like this are a bit unusual, of course. But for customers who need them, we're always ready with the necessary steel-making, forging, treating, and machining facilities. Thorough integration also makes possible a complete line of smaller vessels. (We remember one that weighed only 900 lb!) No matter what your requirements in size or design, we can meet the specifications in full.

Let Bethlehem help you plan new autoclaves, reactors, converters, separators, filters, accumulators. Once the design is approved, our shops will follow through with a first-class production job.

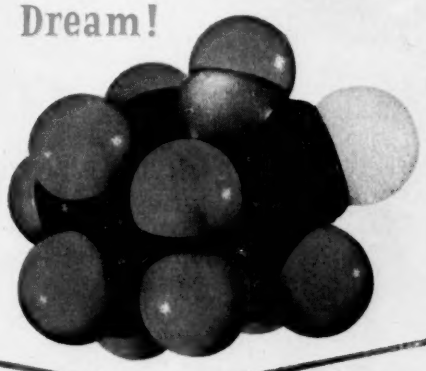
BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

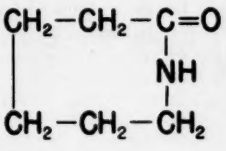
BETHLEHEM STEEL

Development Chemist's Dream!

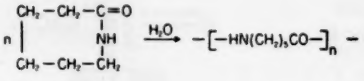


National ε-CAPROLACTAM

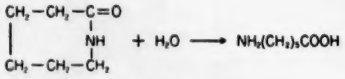
building block for completely new organics



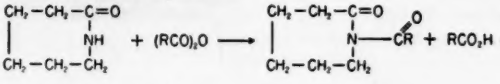
Polymerization:



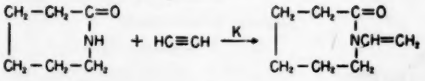
Hydrolysis:



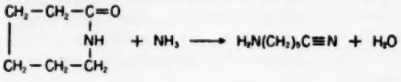
Reaction with Anhydrides:



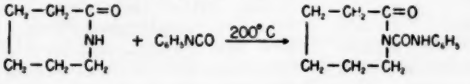
Reaction with Acetylene:



Reaction with Ammonia and Alkyl Amines:



Reaction with Isocyanates:



ε-Caprolactam stands as a challenge to the creative ingenuity of American chemists and chemical engineers. From it can be built completely new commercial chemicals and resulting end-products with properties unknown today.

Consider its unique 7-membered ring, its polymer-forming potentialities . . . its reaction possibilities with other chemicals to create new materials useful to science and industry.

And then remember that this unique monomer is already priced low enough for volume use in resins and fibers.

Send for Technical Bulletin I-14R

Substantial product-development work is being done with National ε-Caprolactam. A considerable body of basic research data already exists. To encourage still wider interest, National Aniline has compiled a new 34-page brochure containing complete properties, known reactions, suggested uses and a comprehensive bibliography. Samples and additional technical help are available to those whose work may develop broader use of National ε-Caprolactam.

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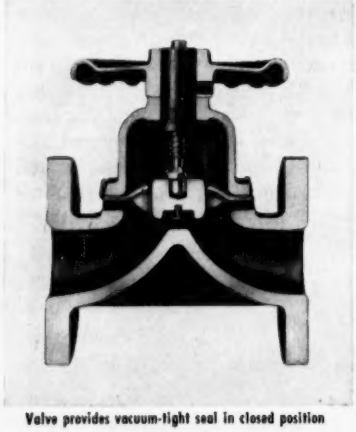
GRINNELL REPORTS ON VALVES:

THE ADVANTAGES OF GRINNELL-SAUNDERS DIAPHRAGM VALVES IN HIGH VACUUM SERVICE

Dependable performance and long service life for vacuums down to 0.1 micron . . . with leak rates of less than 0.1 micron cubic foot/hour

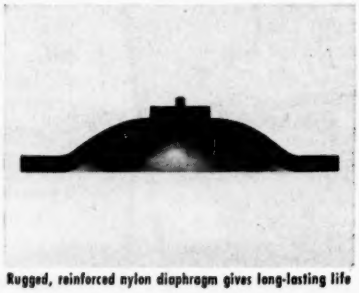
One of the most important requirements of valves for high-vacuum service is that they must be vacuum-tight at all times during their operating cycle. Diaphragm valves of the Grinnell-Saunders manufacture fully meet this requirement. When clamped between the flanges of the body and bonnet, the diaphragm is easily made vacuum-tight down to 0.1 micron — with an in-leakage rate of less than 0.1 micron cubic foot/hour. Whether in the open, throttling or closed position, the diaphragm presents a smooth, unbroken face to the vacuum side of the chamber.



Valve provides vacuum-tight seal in closed position

Rugged, nylon-reinforced diaphragms in a variety of materials

Grinnell has perfected a method of reinforcing its diaphragms with wear-resistant nylon. The result is a diaphragm that lasts longer at high-vacuum. The only part of the valve subject to service wear at any time is the diaphragm — which can easily be replaced in a matter of minutes, without removing the valve body from the system. Diaphragms are available in a wide choice of materials.



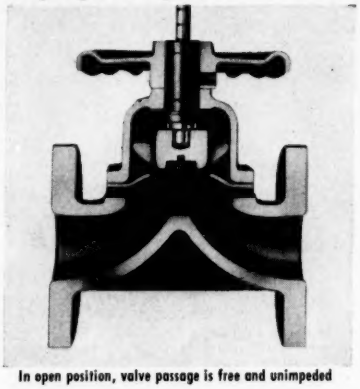
Rugged, reinforced nylon diaphragm gives long-lasting life

Contamination minimized

Construction of Grinnell-Saunders Diaphragm Valves provides separation of the working mechanism from the vacuum within the system. This isolation of lubricated working parts prevents contamination of the system from lubricant outgassing.

Large, unimpeded valve passage

The large passage of the Grinnell valve, in the open position, offers minimum impedance to the escape of random moving molecules in pumping down to high-vacuum, thus shortening the pump-down cycle.



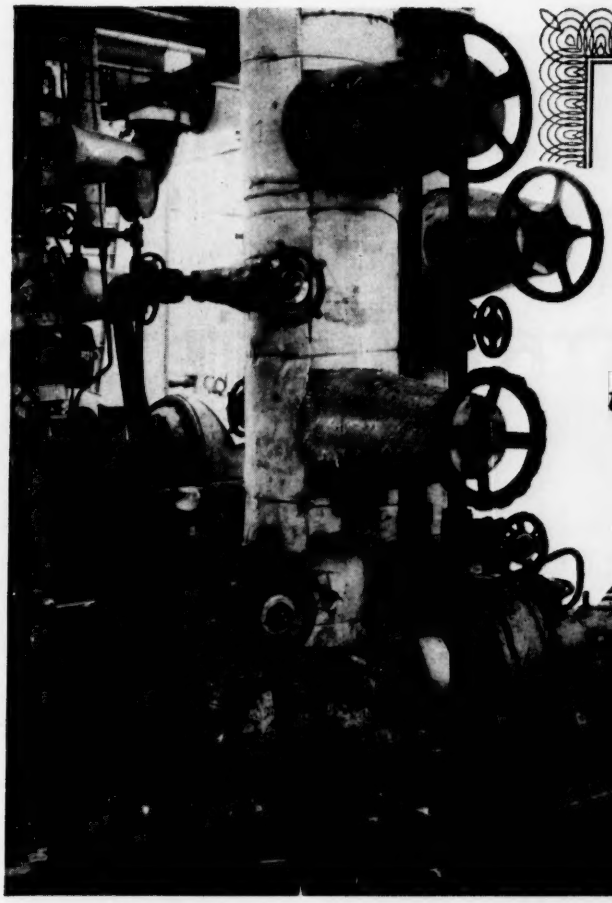
In open position, valve passage is free and unimpeded

Special provisions:

Sealed bonnets are available for evacuation when required. Elastomer type diaphragms do not require evacuation of the bonnet. Valves with plastic diaphragms, used at elevated temperatures, do require evacuation of the bonnet for long diaphragm service life.

For more information

Get further facts about Grinnell-Saunders Diaphragm Valves. Learn, how the diaphragm lifts high for streamline flow in either direction . . . and how the diaphragm seals firmly against the body weir for leak-tight closure. Write to: — Grinnell Company, Providence 1, Rhode Island.



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PEERLESS PUMPS COMBINES QUALITY *with* ECONOMY *in* PROCESS PUMPS

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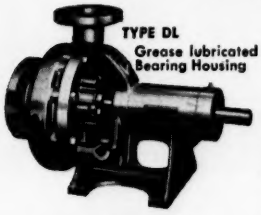
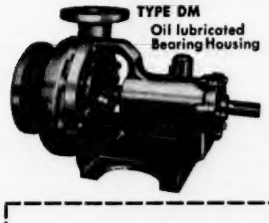
PUT THE IDEA OF PUMP COMPONENT INTERCHANGEABILITY TO WORK FOR YOU FOR SAVINGS IN FIRST COST— IN OPERATION—AND IN MAINTENANCE



TYPE DL
Grease lubricated Bearing Housing



TYPE DM
Oil lubricated Bearing Housing

Here's how component interchangeability works: Shown at the left are two types of Peerless chemical process pumps. The Type DL has a *grease* lubricated bearing housing; the Type DM has an *oil* lubricated bearing housing. To *either* of these bearing housings, you simply add the required backplate, impeller and volute. You "build up" the pump you want with either a water or air cooled backplate or an open or enclosed impeller.

In this way you match the temperature, pressure and other characteristics of the liquid being pumped. You "tailor make" the pump you want by complete component interchangeability—the Peerless idea—the modern idea in process pump buying.

Result: You stock up to 85% less parts; you reduce your capital investment; you obtain maximum versatility in pump application; you always pump with the most efficient pump for the intended service.

Write for NEW 12 PAGE BULLETIN, which completely describes and illustrates the Type DL-DM pump line, including specifications, dimensional data and performance charts. Use the coupon.

Putting Ideas to Work

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PEERLESS PUMP DIVISION, FOOD MACHINERY AND CHEMICAL CORPORATION
301 West Avenue 26, Los Angeles 31, California

Send me Bulletin B-1608 ☐ Have a field engineer contact me ☐

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Name_____ TITLE

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City_____ State_____

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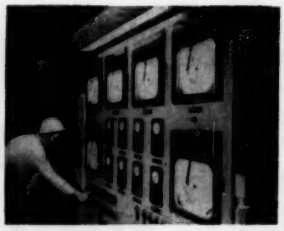


These Bristol Instruments at Lithium Corporation of America, Bessemer City, N. C., are part of an extensive installation that keeps tabs on such variables as temperature, pressure, absolute pressure, flow, liquid level, and pH.

Almost every industry can benefit from BRISTOL INSTRUMENTATION

Here's an outstanding example of the way Bristol is helping thousands of industrial processes today:

In Lithium Corporation of America's plant for extraction of vital lithium compounds, located in Bessemer City, North Carolina, near this nation's largest ore deposits, precision Bristol instruments monitor and control practically every step of the extraction process.

From the early planning stages, Bristol instrument engineers worked closely with Lithium Corporation engineers in designing the instrument system for this modern plant. Temperature, pressure, absolute pressure or vacuum, flow, liquid level, and pH had to be recorded or controlled at a multitude of points in the complex extraction process. The Bristol instruments used included electronic Dynamaster* potentiometers and pyrometers, pneumatic and time program controllers. In operation for nearly four years now, the Bristol instruments have been doing a precise job of recording and controlling despite vibration and a corrosive, dusty environment.

This is just one example of the way Bristol can work with you in selecting the *right* instruments for your process. Bristol makes the most complete line on the market of full-size and miniature instruments for measurement, recording, automatic control and telemetering of almost every industrial variable. And Bristol Application Engineers are always ready to advise and assist you in applying them to your process. Write: The Bristol Company, 109 Bristol Road, Waterbury 20, Conn.

T.M. Reg. U. S. Pat. Off. B-48

BRISTOL TRAIL-BLAZERS IN PROCESS AUTOMATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

MODERNIZING?
PLANNING A DRYING SYSTEM?

ADD
ALL COST FACTORS...

INITIAL COST
INSTALLATION
MAINTENANCE
OPERATING COST
DELAYED PRODUCTION
WASTE

$ $ $ $ $ $ $

For minimum overall cost, invest in a guaranteed performance PROCTOR Drying System. In addition, you get greater productivity, more uniform product, lower labor costs, and longer, more trouble free dryer life.

PROCTOR Drying Systems have proven their efficiency processing chemicals, foods, pharmaceuticals, tobacco, synthetic rubber, textile fibers, veneers, leather, ceramics, glue, gelatin and many other products and on a world-wide basis.

Call your Proctor & Schwartz representative and let him give you the facts, whether your problem involves continuous conveyor, spray, truck, tray or laboratory dryers—Proctor makes them all.

Proctor ®

SPROUT-WALDRON Pointers
for Mixing and Blending • Size Reduction
Size Classification • Bulk Materials Handling • Pelleting and Densifying

Published in the interest of better processing by Sprout, Waldron & Co., Inc., Muncy, Penna.

PRODUCT HANDLING IS FASTER, CLEANER, SAFER BY AIR

at modern C. F. Mueller food processing plant

Moving farinaceous material at the rate of 125,000,000 lbs. per year is a big job, even for C. F. Mueller Company, one of the world's largest producers of macaroni and egg noodle products. Here is what the Sprout-Waldron pneumatic bulk handling installation has accomplished:

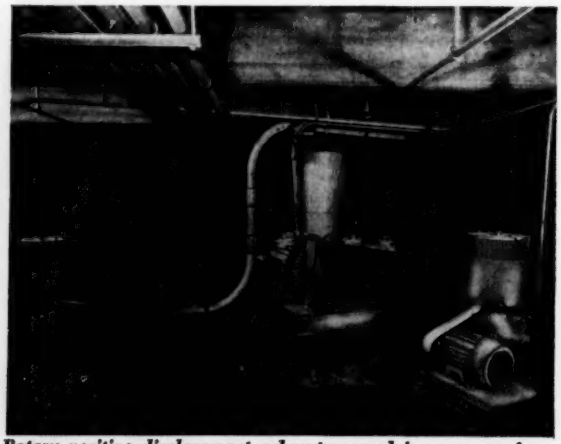
1. Saved more than 25,000 square feet of floor space.
2. Saved approximately $150,000 per year over previous mechanical and manual systems.
3. Simplified the maintenance of high sanitation standards.
4. Released more than $40,000 worth of materials handling equipment for other service.
5. Reduced the accident potential and simplified housekeeping and maintenance operations.

The unloading system consists of a negative pressure pneumatic unit which removes the material from the Airslide cars, elevates it to a product recovery unit from which it is taken by gravity through Gyro-Whip sifters which screen out oversized material and pass the product to a surge hopper. The material is then gravity fed into a scale where it is automatically weighed and recorded, then taken by positive pressure pneumatic system to any one of eighteen steel storage silos with a total storage capacity of 2½ million pounds.

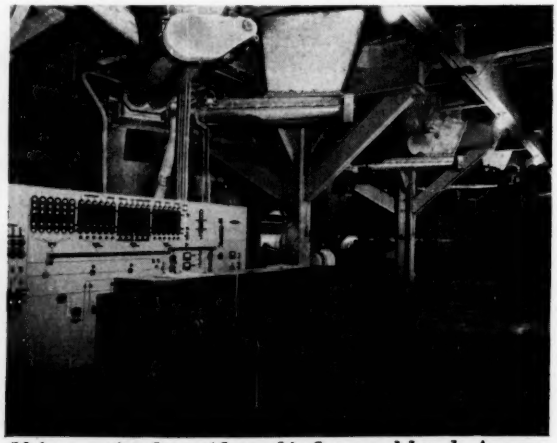
The silos are arranged in clusters of six with screw feeders set up to take the discharge into special blending surge hoppers. The blending system allows for the removal of material from any two or several of the eighteen silos at a pre-determined rate and for combining them into a homogenous blend which is then conveyed by positive pressure to any of the silos.

The positive pressure system is also used to convey the blended material from the storage silos to the processing plant. By a preselected plan this distribution system automatically fills any of the bins in the processing plant as they require material.

The design and engineering of this modern unloading, blending and distribution and storage system was accomplished by means of closest possible teamwork between C. F. Mueller Production Manager, John Curry; Plant Engineer, Charles Becht; Project Engineer, August Stark; and the Materials Handling Division of Sprout-Waldron. The entire operation, which when operating at capacity can receive, blend and deliver to the processing plant approximately 125,000,000 lbs./ year is handled by one man on each shift. For complete details, ask for Bulletin I-47.



Rotary positive displacement exhauster supplying vacuum for unloading operations. In foreground are positive pressure units supplying air to inplant transfer system.



Main operating floor with graphic flow panel board. Arrangement is so flexible that all three major systems can be operated simultaneously.

A complete listing of all Sprout-Waldron products and services will be found in the CEC catalog CP/112

Alcohol—Amyl
Alcohol—Butyl
Alcohol—Ethyl
Alcohol—Methyl
Alcohol—Propyl
Allyl Alcohol (96%)
Allyl Chloride
Alum
Alum, Ammonium
Alum, C
Alu
Al
Al
Ammonium Persulfate
Ammonium Phosphate
Ammonium Sulfate (Saturated)
Ammonium Sulfide
Ammonium Thiocyanate
Amyl Acetate
Aniline Hydrochloride (10%)
Beer
Beet Sugar Liquors
Benzene
Benzoic Acid
Benzol
Benzyl Acetate
Benzyl Alcohol
Black Liquor
Borax
Boric Acid
Brine (acid)
Butadiene
Butyric Acid
Calcium Carbonate
Calcium Chlorate
Calcium Chloride
Calcium Hydroxide
Calcium Hypochlorite
Calcium Nitrate
Calcium Oxide
Calcium Sulfate
Caprylic Acid
Carbon Bisulfide
Carbon Dioxide (dry)
Carbon Dioxide (wet)
Carbon Disulfide
Carbon Monoxide
Carbon Tetrachloride
Carbon Acid
Castor Oil
Caustic Potash (30%)
Caustic Soda (30%)

Chloroacetic Acid
Chlorox Bleach Solutions (5.5 avail. Cl_2)
Chromic Acid—up to 40%
Citric Acid
Coconut Oil
Copper Carbonate
Copper Chloride
Copper Cyanide
Copper Fluoride
Nitrate
Sulfate
Seed Oil
Oil
Ether
Acid
Salt
Alcohol
Chloride
Glycol
Acids
Chloride
Nitrate
Sulfate
Ferrous Chloride
Ferrous Nitrate
Ferrous Sulfate
Formaldehyde (32%)
Formic Acid
Freon F22 (gas)
Freon F22 (Liquid)
Fructose
Fruit Juices, Pulp
Gas—Manufactured
Gas—Natural
Gasoline
Gin
Glucose
Glycerine
Hexanol—Tertiary
Hydrobromic
Hydrochlori
Hydrocyan
Hydrofl
Hydrog
Hydro
Hydr
Sal
Hyd
Hyp
75%
Lact
Lard
Lead
Lemo
Linolei
Linseed
Linseed Oil (Refined)
Liqueurs
Lubricating Oil
Magnesium Hydroxide

Magnesium Sulfate
Maleic Acid
Malic Acid
Mercurous Nitrate
Mercury
Methyl Alcohol
Methyl Bromide
Methyl Salicylate
Milk
Mineral Oil
Molasses
Monoethanolamine
Naphtha
Nicotinic Acid
Nitric Acid (10%)
Nitrous Acid (10%)
Nitrous Oxide
Oil and Fats
Oleic Acid
Orange Juice
Oxygen
Palmitic Acid up to 70%
Perchloric Acid (10%)
Petrolatum
Petroleum Oil (crude)
Petroleum Sour Crude
Petroleum White Oil
Phenylhydrazine Hydrochloride
Phosgene (gas)
Phosgene (liquid)
Phosphoric Acid (10%)
Phosphorus—Pentachloride
Phosphorus—Pentoxide
Phosphorus—Red
Phosphorus—Yellow
Photographic Solutions (all)
Plating Solutions—Brass
Plating Solutions—Cadmium
Plating Solutions—Chromium
Plating Solutions—Copper
Plating Solutions—Gold
Plating Solutions—Lead
Plating Solutions—Nickel
Plating Solutions—Rhodium
Plating Solutions—Silver
lating Solutions—Tin
lating Solutions—Zinc
otassium Aluminum Sulfate
otassium Bicarbonate
Bichromate
orate
romate
omide
rbonate
lorate (aqueous)
loride
hromate
yanide
ichromate (sat.)
rricyanide
Ferrocyanide
Fluoride
Hydroxide (15%)
Hypochlorite
Nitrate
um Perborate
sium Persulfate

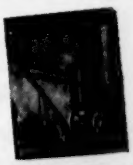
ium Sulfate
ne
ry Brine Solution
Water
Cyanide
ate
15%)
Hydroxide
ypochlorite
Iodide
Sodium Nitrate
Sodium Sulfate
Sodium Sulfite
Sour Crude Oil
Stearic Acid
Sulfated Detergents
Sulfur
Sulfur Dioxide (dry)
Sulfur Dioxide (gas)
Sulfur Dioxide (wet)
Sulfur Dioxide (liquid)
Sulfuric Acid—(60%)
Sulfurous Acid—(6%)
Tannic Acid
Tannic Chloride
Tanning Liquors
Tartaric Acid
Tetraethyl Lead
Thread Cutting Oils
Tomato Juice
Toxaphene (10% in xylene)
Trichloroacetic Acid
Triethanolamine
Triethylamine
Trisodium Phosphate
Turpentine
Urea
Urine
Vegetable Oil
Vinegar
Water Acid Mine
Water—Demineralized
Water—Distilled
Water—Fresh
Water—Salt
Water—Sewage
Whiskey
White Liquor
Wine (20% Alcohol)
Zinc Chloride
Zinc Nitrate
Zinc Sulfate

TEST-PROVEN on over 200 corrosive services

NEW COATED VALVES REPLACE COSTLY ALLOY VALVES

New factory-applied special coatings on Rockwell-Nordstrom standard lubricated plug valves will give you the corrosion resistance benefits of special alloy valves . . . at a fraction of the cost. Now available with K-51[1] and Kanigen[2] coatings, these new coated valves have proven themselves on well over 200 specific services (see list above) which include most caustics, acids and organic or inorganic solvents.

Of course a valve has to do more than just resist corrosion . . . the only real purpose of any valve is to close-off flow. In Rockwell-Nordstrom valves, pressurized lubricant forms a positive pressure barrier against leakage of even lightest gasses . . . and lubrication assures the smooth, easy operation and economy that you just can't expect from anything but a lubricated mechanism.



Get complete details, specifications and application data on the new Rockwell-Nordstrom coated valves in this free booklet. Write: Rockwell Manufacturing Co., Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Limited.

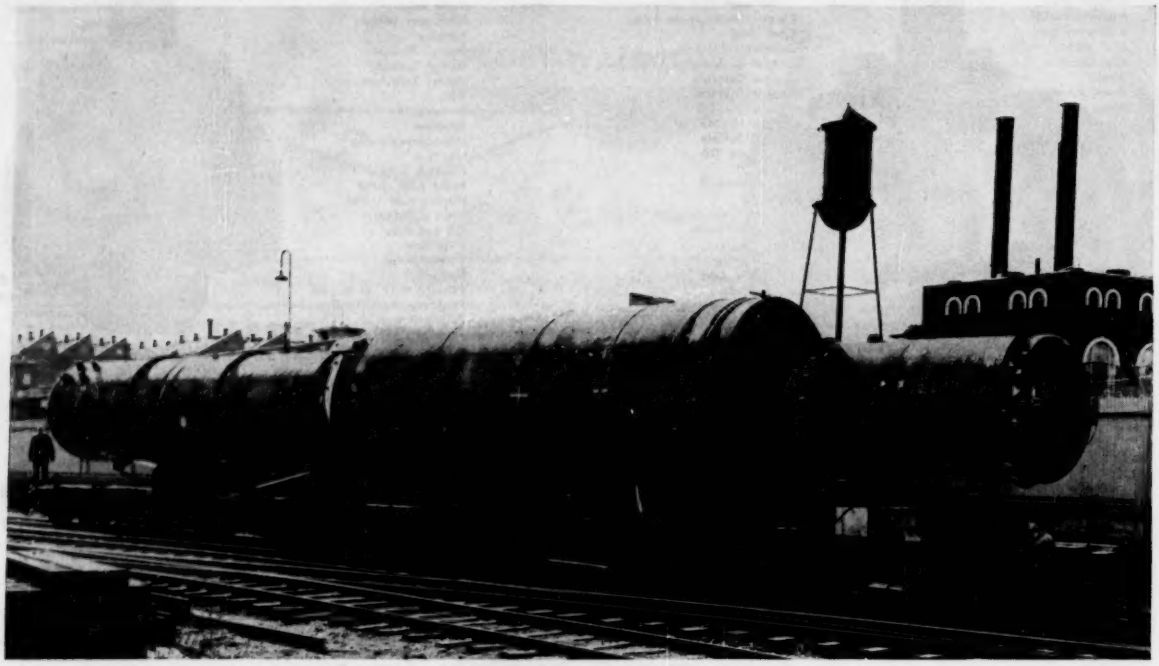
1. K-51 (Penton) is a chlorinated polyether of high molecular weight, linear in nature and crystalline in character.

2. Kanigen coatings, applied by General American Transportation Company, is a chemical coating of 90-92% nickel and 8-10% phosphorus.

ROCKWELL-Nordstrom VALVES

another fine product by

ROCKWELL

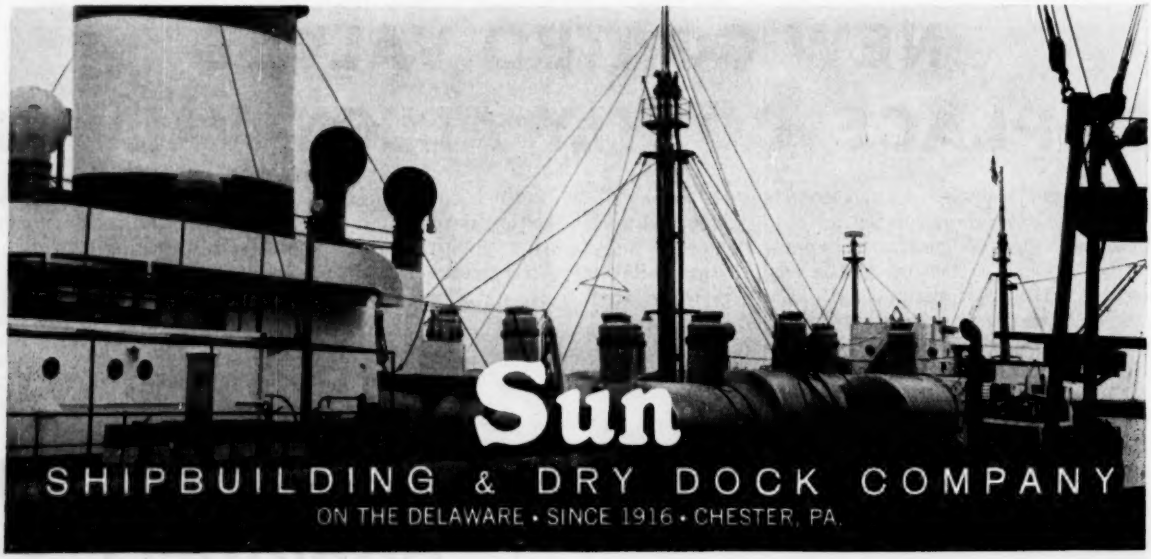


VERSATILITY

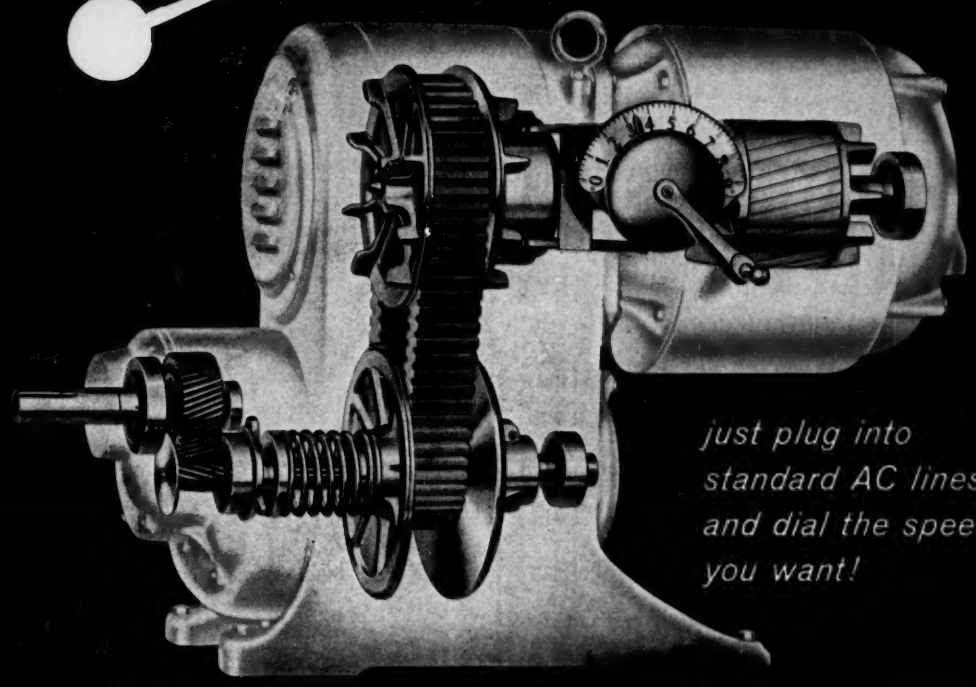
SOLVES PROBLEMS IN SHIPPING PROCEDURE

The variety of large-size work which Sun Ship's shops produce is matched by a variety of equally important shipping problems. Sun's facilities for shipping by water (overseas, coastal, or inland)—directly from our plant, are often the most economical available, and when large pressure vessels, such as those shown here, are scheduled for overseas shipment, direct, plant-to-ship loading saves additional time and expense.

Inland customers benefit from our ability to pre-check clearances and schedule shipments by rail or truck before production ever begins, so that delivery on schedule...on budget...is assured. Thus VERSATILITY...which has been made a "standard procedure" through Sun's experience . . . is extended through one more avenue . . . Shipping Procedure.



any RPM simply on AC!

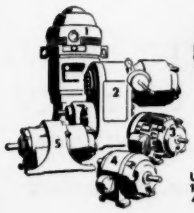


just plug into standard AC lines and dial the speed you want!

U. S. VARIDRIVE Motors

...one unit...infinite speeds!

So *simple* to get any speed you want, directly from standard AC power lines—with U.S. VARIDRIVE MOTORS! One compact, self-contained unit does it. With U.S. VARIDRIVE, you don't have to buy a DC converter, DC generators, complicated and delicate electronic circuits. Just *plug in* this one simple unit—dependable, easy for your regular personnel to maintain. You merely dial, and get smooth, stepless speed changes immediately! Thus, you set speeds for maximum production as needs vary...*increase* machine efficiency...output...product quality! *Decrease* costs...rejects...manpower and materials waste! Available in RATINGS: ¼ to 75 H.P. Specify: "U.S. VARIDRIVE MOTOR."



U.S. MAJOR MOTOR LINES INCLUDE:
1. Vertical Solid & Holloshaft, 2. Varidrive, 3. Totally-Enclosed, 4. Uniclosed, 5. Syncrogear. Also, many other special motors.

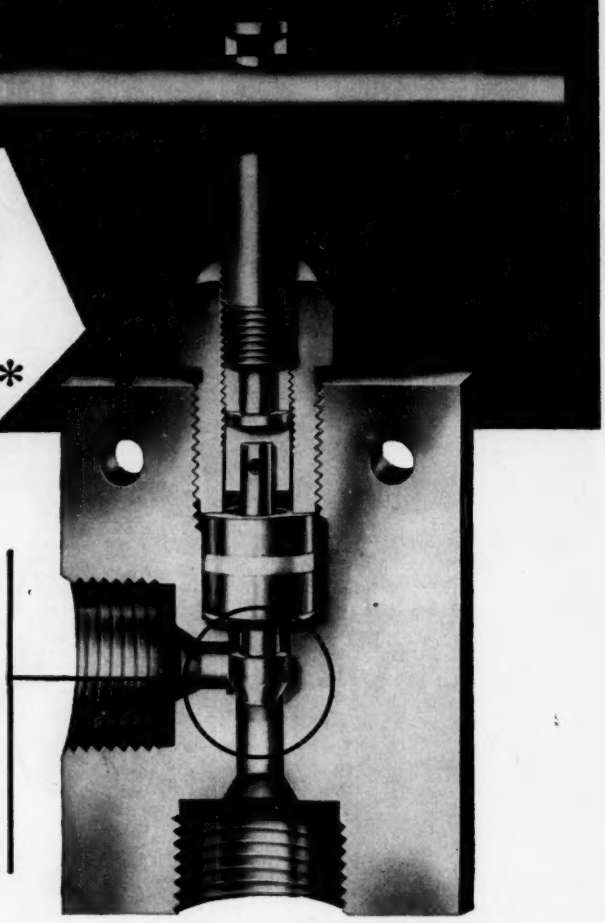
U.S. ELECTRICAL MOTORS INC.

BOX 2058, LOS ANGELES 54, CALIFORNIA
OR MILFORD, CONNECTICUT

FREE COLOR BROCHURE
...Send for U.S. Varidrive Bulletin No. 1797

NEW From AUTOCLAVE ENGINEERS

A MAJOR IMPROVEMENT IN FLOATING-STEM* VALVES



Only This Unique Design Gives You All These Advantages:

- **No "Backlash"** — Stem movement is positive at all times
- **Pre-Loading Construction** — assures operating without "slop"
- **Stem Does Not Rotate Against Seat** — No scoring of either stem or seat
- **Choice Of Lower Stem Materials** — Stainless, hastelloy, monel, etc. (standard stem 316 s.s.)

This major improvement in floating-stem valves gives you operating advantages available in no other valve. When you operate this valve, you get positive stem action immediately . . . no "backlash", no "play", no loss of "feel", and no scoring because the floating stem does not rotate against the seat. You have a choice of lower stem materials such as stainless steel, hastelloy, titanium, monel, etc.

And these new floating-stem valves give you the same finger-tip control, the same leak-proof action characteristic of *all* AE Valves. What's more, you can install the new floating-stem in your present AE Valves—easily, quickly. Whenever corrosion or scoring is a problem, *always* specify AE Floating-Stem Valves.

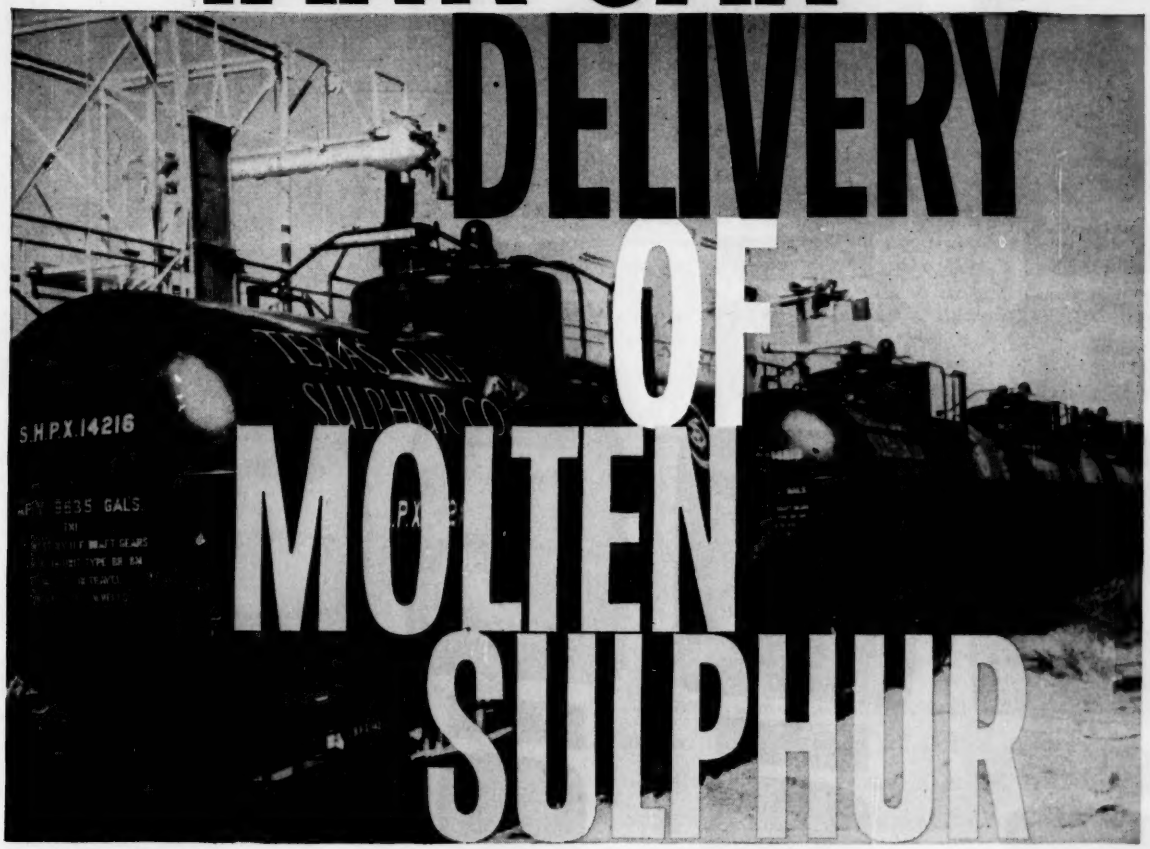
*AE FLOATING-STEM VALVES are patented Pat. No. 2,887,293

For More Details On AE FLOATING- STEM VALVES, Send For Bulletin 5152-A

AUTOCLAVE ENGINEERS, INC.

2932 WEST 22nd STREET, ERIE, PENNSYLVANIA

TANK CAR DELIVERY OF MOLTEN SULPHUR



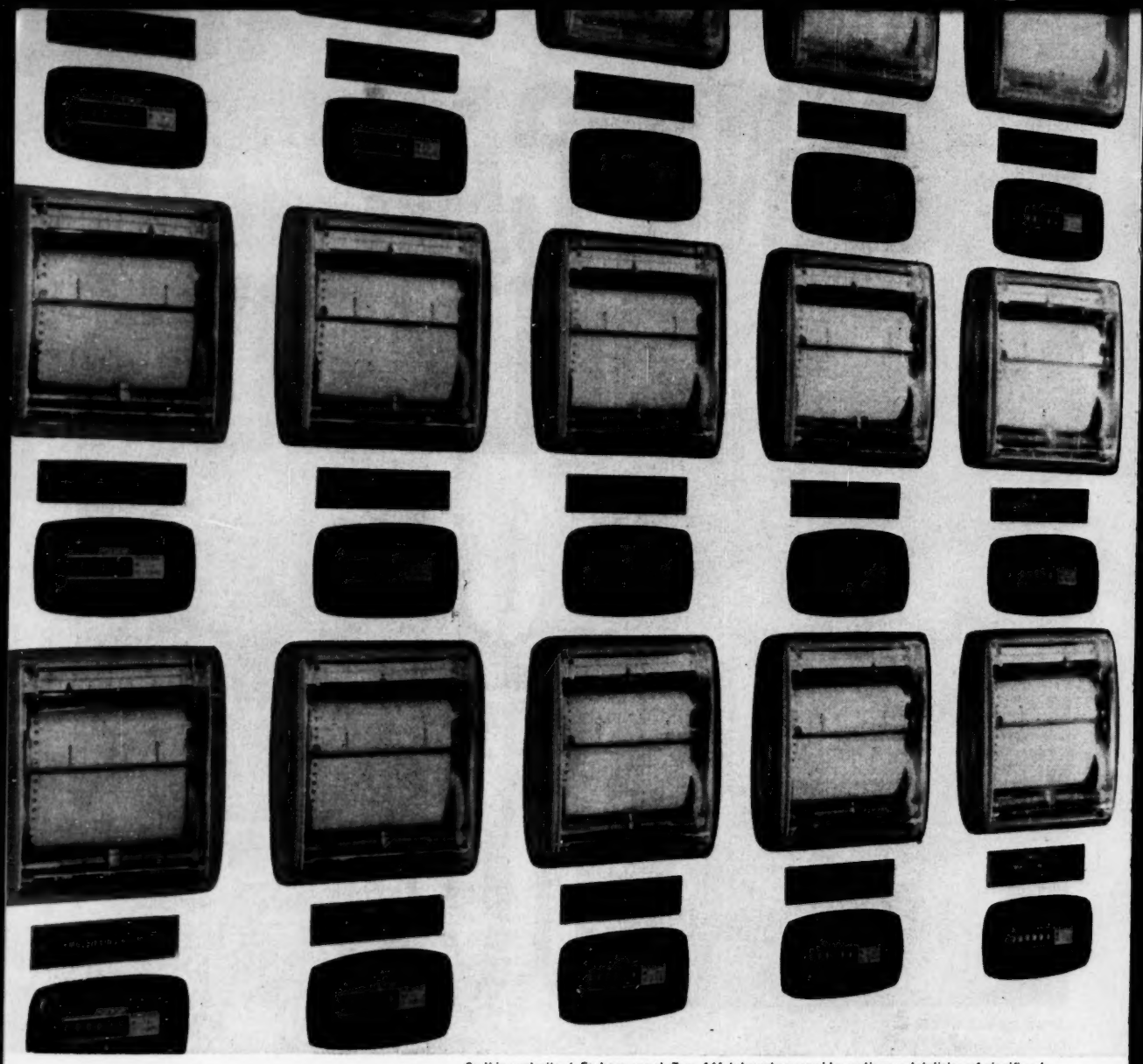
Loading Tank Cars at one of our mines

...an important phase of TGS Service

This is a service of interest to the rapidly increasing number of companies preferring to receive their sulphur deliveries in molten form so that they can transfer directly from cars into consumption. We are equipped now to deliver molten sulphur by tank car from all mines and recovery plants to any place in the country. Detailed instruction sheets and drawings are available on request for those in the planning stage or who do not have adequate or proper facilities for handling and storing molten sulphur.

TEXAS GULF SULPHUR COMPANY
75 East 45th St., New York 17, N. Y. / 811 Rusk Ave., Houston 2, Texas

Sulphur Producing Units: Newgulf, Texas • Spindletop Dome, Texas • Moss Bluff, Texas • Fannett, Texas • Worland, Wyoming •



On this centralized Foxboro panel, Type 14A Integrators provide continuous totalizing of significant process and plant service flows – recorders give trend records required by operating personnel.

Simplest way to get continuous, accurate totalizing

of all process and plant service flows

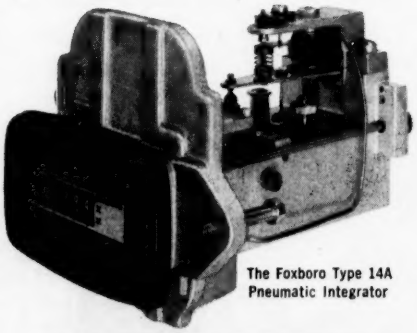
For automatic flow-accounting of all process and plant service fluids, Foxboro Type 14A Pneumatic Integrators offer unparalleled advantages of accuracy, convenience, and economy.

Easily connected to signal lines from new or existing Foxboro d/p Cell* Flow Transmitters, 14A Integrators provide **continuous** totalizing of significant flows. They can be mounted with the d/p Cell at the point of measurement, or panel-mounted hundreds of feet away.

The square root function is automatically extracted — flow totals are read directly. A simple, inherently accurate, centrifugal force system eliminates the errors of cams, special chambers, linkages, and intermittent counting.

Bulletin 13-23 fully illustrates and describes the Type 14A Pneumatic Integrator, and points the way to economical accounting of process and plant service flows. Write for your copy today. **The Foxboro Company, 368 Neponset Ave., Foxboro, Mass.**

*Reg. U.S. Pat. Off.



The Foxboro Type 14A Pneumatic Integrator

FOXBORO

REG. U.S. PAT. OFF.

Fig. 8001 Screwed Ends. Sizes ½" to 2"
Fig. 8002 Socket Welding Ends

A New Lunkenheimer Valve

CHECK THE FEATURES OF THIS LUNKENHEIMER FORGED STEEL GATE VALVE

This new Lunkenheimer Forged Steel Gate Valve is already building a reputation for rugged service. Completely new in design, it's compactly built for fast installation in the most cramped quarters. Produced with famous Lunkenheimer materials and highly-skilled workmanship, it handles pressures of 800 lbs. at 850°F., and 2000 lbs. at 100°F. easily and safely. Discs are 13 Chrome Stainless Steel, heat treated completely through to 500 Brinell hardness to eliminate chipping or cracking. Rolled-in Seat Rings can't work loose. This newest addition to the world-famous Lunkenheimer line can help solve *your* valve maintenance problems. Call your Lunkenheimer Distributor, or write us for literature. The Lunkenheimer Company, Cincinnati 14, Ohio.

BRONZE • IRON • STEEL • PVC

E-1067-4

LUNKENHEIMER QUALITY

LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES

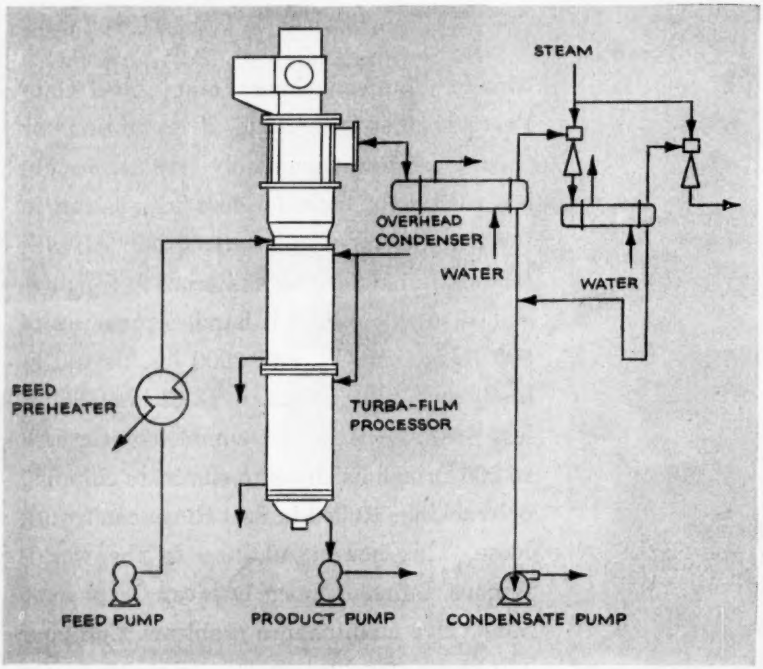
RODNEY HUNT

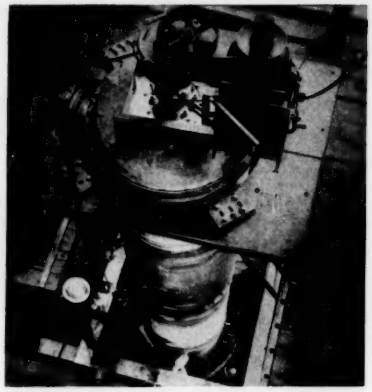
FLUID PROCESSING

RODNEY HUNT MACHINE CO., Process Equipment Division, 31 VALE STREET, ORANGE, MASS.

RODNEY HUNT PROCESSORS PROVIDE A SIMPLIFIED SOLUTION TO COMPLEX PROCESSING PROBLEMS

Rodney Hunt Turba-Film and Vacu-Film Processors have proven to be extremely versatile not only in the range of industries and products they serve, but also in the different kinds of processes they perform. These units assure closely controlled uniformity of product in processes such as – distillation . . . steam distillation . . . concentration . . . deaeration . . . deodorization . . . liquisolids . . . desolventization . . . and homogenization. The flow chart below illustrates a typical DISTILLATION process – one of the widest applications for the Turba-Film Processor. In this flow sheet, caprolactum is distilled from a residue consisting of dimers and trimers. Short time of contact and positive flow make the Turba-Film unit ideal for heat-sensitive and time-sensitive materials. Multi-stage units can also be used depending on the requirements of the process.





LARGEST TURBA-FILM PROCESSORS IN PRODUCTION AT RODNEY HUNT

Three large Turba-Film Processors have been ordered to increase production in the concentration of urea solutions. Each Processor has three inside thermal sections, 42″ in diameter and 72″ long. From the top of the integrally-mounted drive to the bottom of the unit, including thermal sections and separator, each Processor will measure 31′. The photograph above shows one of the Processors being readied for inspection and test runs in the test stand at Rodney Hunt.

The picture on the right shows the Turba-Film Processor's 27 ft. stainless steel rotor being acid cleaned in preparation for final finishing.

FILL IN COUPON FOR MORE INFORMATION ABOUT RODNEY HUNT PROCESSING EQUIPMENT

Please send me the bulletins checked.

- ☐ THE TURBA-FILM PROCESSOR
- ☐ THE VACU-FILM PROCESSOR
- ☐ THE LABORATORY VACU-FILM PROCESSOR

Name.....

Title.....

Company.....

Address.....

Mail to: Rodney Hunt Machine Co., Process Equipment Division, 31 Vale Street, Orange, Mass.

The photograph above shows special machine tools required for boring the inner shells of the Turba-Film Processor. Because of precision requirements, close tolerances must be maintained between this wall and the blades of the rotor.

DEVELOPMENTS...

AUGUST 10, 1959

Chementator

C. H. CHILTON

Dow Chemical Co. has obtained license from Ajinomoto in Japan, effective with issuance of U. S. patent, for production and sales of synthetic amino acid threonin. Retail price in Japan is $55.55/kilo.

Crown Zellerbach Corp. will take first step into manufacture of integrated forest products at Columbia City, Ore., with modern sawmill which can supply wood waste for pulping.

Calumet & Hecla, Inc., will start experimental production this fall of lightweight seamless metal tubing that can be shipped in collapsed ribbon coils and inflated at point of use.

Noralyn Paper Co. will build 400 tons/day mill at Baton Rouge, La., to produce first high-quality newsprint exclusively from hardwoods, using continuous pulping process developed by Herty Laboratories.

Patent ends guessing on heavy water

With issuance of U. S. 2,895,803 on July 21, the veil of secrecy lifted from Jerome Spevack's dual-temperature exchange process for making heavy water.

Improved process operates on the same principle as its forerunner described in earlier U. S. 2,787,526. Deuterium, present in all water at a concentration of one part in 7,000, undergoes enrichment by transferring to H_2S gas at high temperature and back to water at low temperature. Spevack's innovations disclosed in the patent, which are incorporated in AEC heavy water plants at Aiken, S. C., and Dana, Ill., shrink high operating costs by heavy reductions in energy consumption.

Instead of cycling all the flow of gas and water between hot and cold sections of each stage, Spevack splits off the enriching gas stream and feeds it forward through only the hot columns for each stage and back through the cold columns; enriching water feeds forward through the cold columns and back through the hot columns. Thereby, there is much less alternate heating and cooling of flows.

At the same time, Spevack uses a closed cycle to preheat and humidify the large volume of gases passing from cold to hot column of each stage. Cold gas is heated and humidified by direct contact with hot water in a bubble-cap column. Cooled water from bottom of bubble-cap column then cools and dehumidifies the same gas, after it passes through hot column, by indirect exchange in shell-and-tube exchanger. Reheated water from this exchanger then returns to direct contact humidifier-heater. Only a small amount of steam is needed to compensate for cycle losses.

Additional savings are realized by stripping H_2S from waste water with steam entering hot tower.

Altogether, Spevack claims these process tricks reduced operating costs of the original dual-temperature exchange process about $50/

CROUSE/HINDS

Condulet®
electrical equipment

the one complete line for corrosive locations

Photo shows Feraloy Condulet conduit fitting after several years exposure to hydrochloric acid. Note extreme deterioration of conduit.

RESISTS chemical and galvanic corrosion

RESISTS acids, alkalis, salts

RESISTS varying concentrations and temperatures of corrosive liquids, vapors, gases, dusts

Corrosion problems would be simple if there were a single material which would resist all corrosive substances.

Since there is not, Crouse-Hinds provides electrical equipment in four materials which offer a selection to meet virtually every known corrosion problem . . .

FERALOY® features the desirable characteristics of cast iron: strength, corrosion resistance, versatility, adaptability, economy. Plated with zinc and cadmium, Feraloy Condulets will combat most corrosive elements.

ALUMINUM ALLOY develops its own self-repairing oxide film which resists a number of corrosive conditions. Copper-free Aluminum Alloy Condulets effectively resist galvanic corrosion.

PLAST-A-COAT, a polyvinyl chloride, is a resilient coating which withstands abrasion and repels corrosion from caustics, alkalis and heavy mineral acids. Tough, non-peeling, it also acts as an insulator.

SILICON BRONZE, when all other materials fail, can be furnished for the most extreme corrosion problems. Counteracts virtually all alkalis as well as salt water, sulfur gases, etc.

CROUSE HINDS
SYRACUSE NEW YORK

Write for **BULLETIN #2699** containing full information on Crouse/Hinds Condulets for Corrosive Locations.

Offices: Atlanta, Baton Rouge, Birmingham, Boston, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Corpus Christi, Dallas, Denver, Detroit, Houston, Indianapolis, Kansas City, Los Angeles, Milwaukee, New Orleans, New York, Omaha, Philadelphia, Pittsburgh, Portland, Oregon, St. Louis, St. Paul, Salt Lake City, San Francisco, Seattle, Tulsa, Washington. **Resident Representatives:** Albany, Baltimore, Reading, Pa., Richmond, Va.
Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.
Crouse-Hinds Instrument Company, Inc., Silver Spring, Md.

lb. of heavy water. With a present operating cost of about $13/lb., Spevack's process holds a strong position in upcoming bids for heavy water business, in view of present quoted world market price of $87/lb.

Benzene feed cuts terephthalic cost

Terephthalic acid can be made directly from benzene, says Henkel & Co., using a streamlined version of the company's process in which the potassium salts of aromatic acids are rearranged (*Chementator*, Jan. 13, 1958, pp. 76-78).

In the new process, benzene reacts with potassium carbonate under pressure at 350 C. to produce potassium terephthalate. Reaction uses a cadmium catalyst and is carried out in the presence of aluminum carbide, which keeps things dry and provides a blanket of acetylene. Terephthalic acid is "sprung" from the potassium salt with an acid.

The German firm has licensed its new process to those companies already licensed to use older versions—Badische in Germany, Kawasaki and Teikoku in Japan, ICI in Britain and Hercules in the U. S. Kawasaki, which began commercial use of the Henkel process last year (*Chementator*, Sept. 22, p. 69), is said now to be using the new, shorter route.

In one of the early versions of the Henkel process, potassium orthophthalate is made from phthalic anhydride, then isomerized to potassium terephthalate. In another version—favored by Hercules—two molecules of potassium benzoate are disproportionated to get potassium terephthalate plus benzene. The benzoic acid would normally be made by oxidation of toluene.

The new process thus substitutes low-cost, abundant benzene for the more costly phthalic anhydride or benzoic acid starting materials.

New activity livens foam prospects

Foam separation, a promising new tool for removing metals from solution, now has a second backer.

Armour & Co., Chicago, has filed patent applications in the U. S. and 31 other countries under rights it acquired to a technique conceived by Felix Sebba of Witwatersrand University, Johannesburg, South Africa. Sebba found that certain soaps (e.g., potassium laurate), when added to a mineral-containing solution, would chase the mineral (e.g., cobalt) to the surface when bubbles of gas were blown through the water.

Sebba's technique is similar to—and possibly identical with—one already under development by Radiation Applications Inc., New York (*Chementator*, Sept. 8, 1958, p. 53). Inasmuch as RAI also has patent applications on file, questions of conflicting claims and priorities may arise.

In the past year RAI has made further significant advances in this field. Working under AEC sponsorship on removal of radioactive strontium and cesium from nuclear wastes, RAI thinks it has found a way to get the desired decontamination factors of 10^6-10^7. This involves use of a series of continuous foam-separation columns. A single column can get a decontamination factor of 100; a countercurrent series of three columns could thus achieve a factor of 10^6.

Early work met with difficulty in getting cesium into the foam phase when strontium was present. RAI has now discovered that addition of sodium tetraphenyl boron along with the foaming agent does the trick. Presence of strontium actually enhances this effect.

Of potential commercial importance is RAI's technique for separating cobalt from nickel by foaming. Another intriguing prospect is foam separation of rare earths. Details are under wraps until the patent situation is clarified.

Neurons inspire electrochemical switch

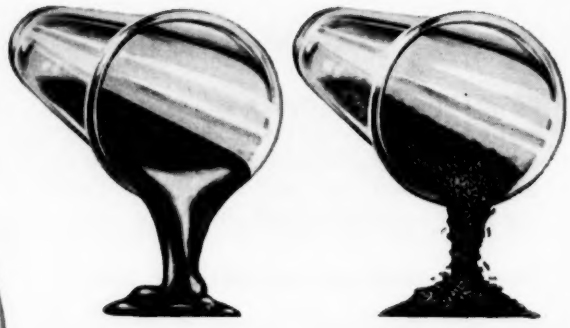
Electrochemistry—an entirely new approach to static switching—promises soon to have as much impact on high-power circuit control as solid-state physics have had in the low-power field.

A new electrochemical relay, just introduced by Ovitron Corp., Detroit, is claimed to be "capable of switching and modulating almost any amount of alternating current, endlessly and continuously without wear, disintegration or loss of efficiency."

Based on the modern nerve-cell theory of electro-ionic surface impedance change, this radical device basically consists of two load-connected, oxide-coated electrodes and a grid control element, all immersed in an electrolytic bath. All components can be encapsulated within a thumbnail-size cylindrical container.

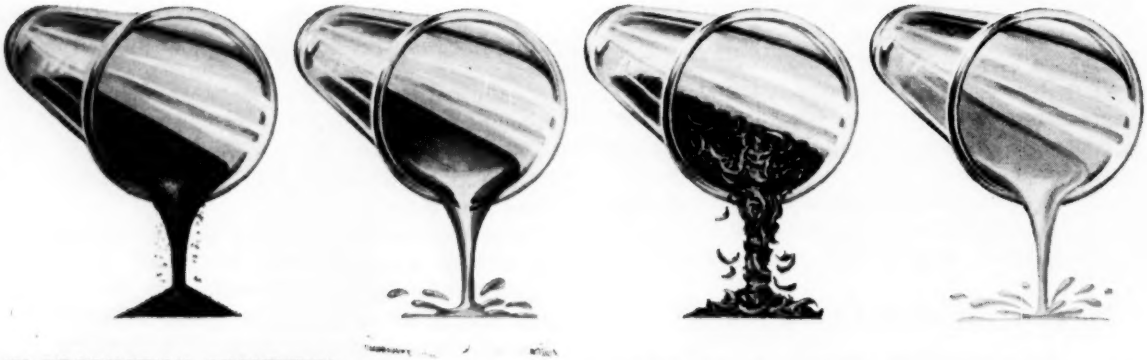
On application of a small d.c. stimulus to

(Continued on page 56)



NEW WORLDS OF BLENDING

BLENDS ANY



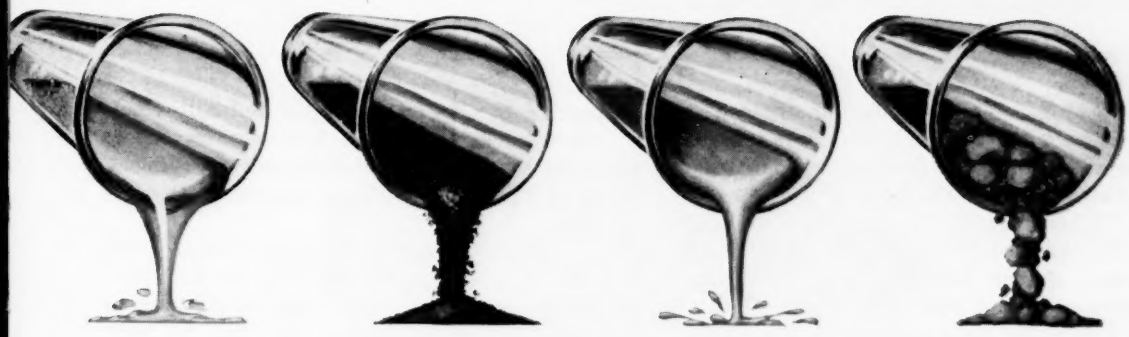
IN PRODUCTION QUANTITIES. A new centrifugal force Liquid-Solids blender has evolved from P-K's exclusive "Twin-Shell" design. It blends never-before-practical combinations of liquids and solids! It reduces conventional blending operations to a single step!

For new combinations of liquids and solids, this amazing blender offers untold advantages. Applications are limited only by imagination. They range from chemical reactions to coating very light solids such as cork, to producing all types of controlled granulations from fine to coarse.

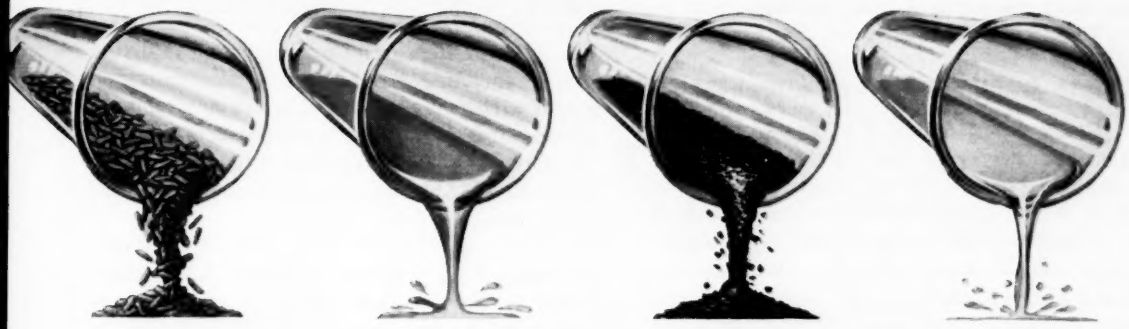
In conventional applications, the one-step P-K Liquid-Solids blender often eliminates two and three separate stages of blending, pulverizing and screening. It replaces a multiplicity of equipment. It reduces equipment investment and materials handling costs.

P-K Liquid-Solids units blend up to 40% liquids by weight. Blending requires minutes, not hours. It involves four simple actions: 1) Dry Solids are charged to about 65% of shell volume. 2) Solids are tumbled and aerated to break up agglomerates. 3) Atomized liquid is dispersed through patented centrifugal force spray discs. 4) Product is discharged from the bottom of the blender.

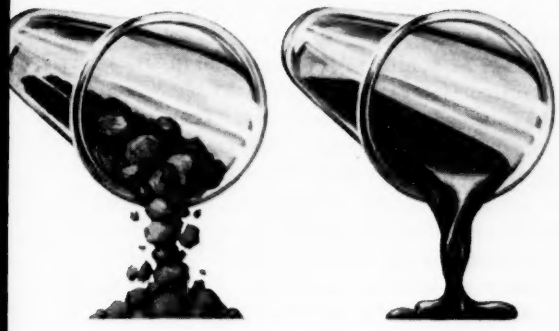
All surfaces of the blender are freely accessible. The

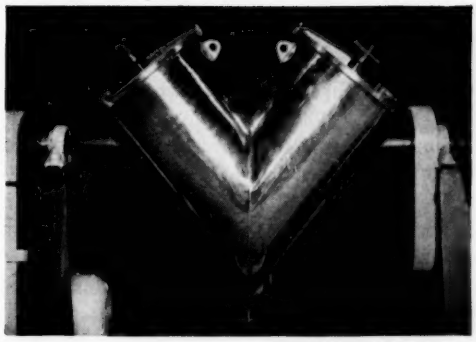


POSSIBILITIES



LIQUID WITH ANY SOLID!





Liquid-Feed bar is easily removed. These features speed cleaning and safeguard against contamination. Sizes range from laboratory models to 50 cu. ft. capacity.

FREE PRE-TEST OFFER. You can preview blending economies at our Laboratory. Pre-testing predicts savings in processing and handling and realistically demonstrates the unique performance of this blender.

Our pre-test facilities for blenders – and also for P-K Vacuum Tumble Dryers – are at your disposal. Send or bring your test materials. For complete information call (Stroudsburg – Hamilton 1-7500) or write George Sweitzer at our East Stroudsburg Headquarters, 1508 Hanson Street. 15

Patterson Kelley

Chemical and Process Equipment Division, East Stroudsburg, Pennsylvania

the grid element, the oxide film on each electrode becomes permeable to certain ions. This allows delivery of alternating current through the electrolyte to the load.

When the grid signal is removed, the electrodes become nonconductive, and current ceases. During operation, the grid current forms some gas. This is returned to solution by a catalytic probe sealed within the cell.

Potential applications for electrochemical relays have not yet been fully explored. But laboratory models have found use as logic devices, modulators, error detectors, amplifiers, etc. Current ratings of Ovitron's prototype units range to 4 amp. Voltage span is 3 to 70 v. a.c.

Nuclear designers aim for superheat

Rising to demands for modern power-steam conditions, at least four major companies are pushing nuclear superheaters.

The A.E.C. just awarded General Electric Co. a $2.7-million contract and Combustion Engineering-General Nuclear Engineering Corp. a $1.6-million contract to develop boiling-water nuclear superheaters. Recent success at GE's Vallecitos Boiling-Water Reactor proves that stainless-steel construction withstands radiation from 825-F., 930-psi. steam.

General Dynamics, following the British tack, is designing a $24.5-million, high-temperature, helium-cooled reactor (HTGR) for High Temperature Reactor Development Assoc., Inc. A HTGR will be constructed for Philadelphia Electric Co. to produce steam at 1,000 F. and 1,200 psi. Helium-cooled reactor will consist of graphite-clad, uranium-thorium carbide fuel elements in a steel pressure vessel.

General Dynamics' spokesman reports that Hawker Siddeley of England may supply required graphite, impermeable to helium and fission-product gases. Studies to determine steel-graphite and helium-steel compatibility are not yet completed.

Atomics International recently produced superheated steam (1,050 F.) at its Sodium Reactor Experiment (*Chem. Eng.*, June 30, 1958, pp. 90-93). AI points out that no special materials of construction are required to produce superheated steam in sodium- or organic-cooled reactors.

Under contract to Northern States Power Co., Sioux Falls, S. D., Allis-Chalmers is now designing a gas-cooled reactor to superheat steam to be generated in NSP's boiling-water reactor, to 825 F. and 540 psi. But Allis-Chalmers votes for integral boiling-water superheaters, points out that steam generated in the reactor may be sufficiently superheated therein.

All four reactor designers concur that nuclear superheaters may be fueled with low-U-235-enrichment fuels when higher thermal efficiencies are achieved. Till then at least partially enriched fuels must be used.

Aluminum adds whoosh to propellant

Add aluminum to the list of materials now used in solid rocket fuels. At recent dedication of its $1-million headquarters near Alexandria, Va., Atlantic Research Corp. disclosed that its new propellant, Arcite, contains aluminum mixed with polyvinyl chloride and ammonium perchlorate. Aluminum increases boost velocity of rockets by 10-30% and range or altitude by 20-60%. Aluminized propellant now drives the Polaris sea-to-air missile.

While aluminum's high heat of combustion makes it a prime candidate for rocket fuels, it took a neat piece of engineering reasoning to bring success to ARC's Arcite.

If you base the thermodynamics of an aluminized system on conventional stoichiometric proportions of about 80% oxidizer, 10% binder and 10% aluminum, water would dissociate at the high temperature and absorb the heat that aluminum contributed. Thus, you defeat your purpose.

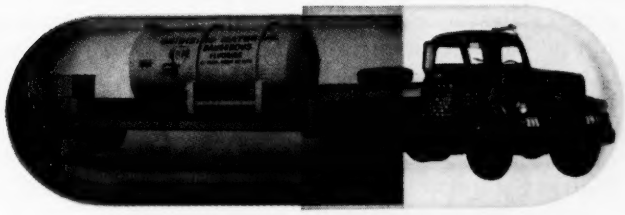
ARC's reasoning: Add aluminum in "massive" proportions, using less oxidizer. Then you have a reducing system. Heat from combustion of aluminum raises theoretical flame temperature to about 5,600 F., with no risk of dissociation reactions. Resulting higher temperature and lower molecular weight of combustion products gives higher specific impulse.

Thermodynamics indicates that about 20% aluminum in the propellant will insure a system of reducing nature.

New catalyst makes good process better

First commercial unit for producing isobutane by Universal Oil Products' Butamer process went on stream last month. It's at Standard of California's Richmond (Calif.) refinery and is conservatively rated at 2,000 bbl./day of isobutane output.

This unit features a new catalyst which shows marked improvements over the plati-



CAPSULE REPORT ON ELEMENTAL FLUORINE

from General Chemical

Initial interest in elemental fluorine has centered largely around military and atomic energy uses. Now commercially available in tonnage quantities, fluorine is receiving increased attention for industrial purposes. For those surveying potential uses of this highly reactive material, General Chemical has prepared this condensed report.

As America's foremost producer of elemental fluorine—and sole supplier of liquid fluorine—General Chemical is well equipped to work cooperatively with users in every area—research, development, engineering, and plant scale handling.

Availability	Readily available from two producing locations: Metropolis, Ill. and Baton Rouge, La.
Forms of Shipment	As a gas, in 6 lb. net cylinders. As a liquid, in 5,000 lb. tank transports. We are also prepared to discuss "over the fence" pipeline deliveries.
Price	At present production levels, fluorine is priced substantially lower than many people have thought. Single 6 lb. cylinders: $15.00 per lb. and downward, depending upon circumstances. Tank Transports of liquid fluorine at under $4.00 per lb. Substantially lower prices would apply for "over the fence" deliveries of gas.
Materials for Handling	Handled safely in many standard materials of construction such as aluminum, copper, brass, steel, stainless steel, Monel, and nickel. We can offer constructive suggestions on preferred methods.
Literature	"Fluorine"—21 page technical data bulletin "Liquid Fluorine Unloading Procedure" "Handling Elemental Fluorine in the Laboratory"—describes safe, simple method for handling. *Available free upon request on business letterhead.*

First in Fluorine Chemistry

Allied Chemical

GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N. Y.

num-containing catalyst UOP employed in early development work (*Chem. Eng.*, Apr. 21, 1958, p. 66). The original catalyst operated at 600-850 F. to yield an equilibrium concentration of isobutane in the reaction product of 40-50 mole %. The new catalyst will get conversion levels of 55-60% at operating temperatures well under 500 F.

With the new catalyst Socal will be able to boost its isobutane output considerably beyond the original rating of 2,000 bbl./day—probably up to 3,200 bbl. A lower operating temperature is now possible. Socal also saved money in construction costs; a low-chrome alloy is used for the reactor instead of the stainless steel originally planned.

UOP hasn't revealed composition of catalyst except to say that it contains a noble metal. Catalyst is sensitive to certain poisons (e.g., sulfur).

Socal's Butamer unit is integrated with new catalytic cracking and alkylation facilities at Richmond. Cat cracker turns out a stream of butane, isobutane and butylenes, but its ratio of isobutane to butylenes falls short of the 1.2 desired for alkylation to isooctane. The Butamer unit remedies this deficiency by converting cat cracker butane, plus butane from other sources, into the needed isobutane.

Industry shares in water desalting

Private industry is contributing major backing for the government's first plant to demonstrate conversion of sea water to fresh water. In his July 14 disclosure that plant will be located at Freeport, Tex., Sec. of Interior Seaton acknowledged that Dow Chemical Co.'s aid was a major factor in this choice. Substantiating this acknowledgement, Dow's A. P. Beutel, VP in charge of Gulf-Coast operation, says that Dow encouraged choice of Freeport over 29 other Gulf-Coast cities by offering to:

- Donate a 5-acre site adjacent to Dow's plant, 2 mi. from the Gulf.
- Supply 40,000 lb./hr. of 30-psi. steam to the demonstration plant at 45¢/1,000 lb.
- Supply sea water from Dow's intake flume.
- Dispose of concentrated brine effluent from demonstration plant.
- Purchase at least 50% of the fresh water output at 30¢/1,000 gal. for use as boiler feed water and agree to increase this purchase to 75% should the city of Freeport fail to use all its 50% quota.

In return for its backing, Dow hopes that this project eventually will attract more diversified industries to the area and expand chemical markets. Aside from broadening the supply of fresh water, the demonstration plant possibly could become a supplier of concentrated brine which is four times more saline than sea water. So Dow plans to conduct research on utilizing this concentrated brine.

Demonstration plant will use W. L. Badger & Co. long-tube vertical evaporator to produce 1 million gal./day of water having less than 500 ppm. salinity for about $1/1,000 gal. The Office of Saline Water hopes to start constructing the $2 million plant by mid-1960, provided Congress grants $1.5 million supplemental appropriation.

OSW also seeks permission from the Solicitor General for negotiated bids so that it can let W. L. Badger & Co. handle the project on a turnkey basis. Whether the plant will be operated by contract or by the Dept. of Interior has not been determined.

No phenol passes ozone checkpoint

Phenol—the most toxic and hard-to-remove constituent in refinery waste water—has a new enemy: Ozone. Cities Service at its new Trafalgar refinery in Bronte, Ont., employs ozone for the first time in the industry to reduce phenol to minute quantities—below the 0.015 ppm. level "suggested" by the Ontario Water Resources Commission.

Cities Service uses a three-stage biological oxidation to get rid of most of the phenol (originally around 55 ppm.) and other chemicals in the waste water. But after thorough biological treating, phenol level is still around 0.38 ppm. Water (around 300 gpm.) then flows into the top of a stainless steel vessel (20 ft. high, 15 ft. dia.) and contacts ozone which bubbles up from the bottom.

After ozone oxidation and subsequent treating with 1-2 ppm. activated carbon, phenol level is reduced to 0.012 ppm.—pure enough to support aquatic life in a large aquarium adjacent to the waste control plant.

Ozone generator-contactor combination cost around $120,000. The 15,000-v. ozone unit produces 190 lb./day ozone from atmospheric oxygen for 8-9 kwh./lb. Chlorine dioxide could effect the same results for lower capital investment, but operating costs would be higher.

For more on DEVELOPMENTS.....60

in IR heavy-duty compressors

these EXTRA-VALUE FEATURES mean top performance and economy

FULL-FLOATING ALUMINUM BEARINGS
Roll with the punch of each stroke to distribute load

SEALED FRAME
Keeps dirt out • Keeps oil in
Keeps wear down

AIR-CUSHIONED CHANNEL VALVES
Highest efficiency • Exceptional durability • Quiet operation

FULL FORCE-FEED LUBRICATION
Filtered oil under pressure to all bearing surfaces

take CHANNEL VALVES for example...

exclusive air-cushioned action means long life, high efficiency and quiet operation

The air-cushioned I-R Channel Valve is the greatest advance ever made in compressor valving, and is entirely different in principle and design. No other valve can approach its efficiency, quietness and almost unbelievable durability. The Channel Valve has eliminated the major problem of impact, without using heavy parts which kill efficiency or frail elements which soon break or wear out.

The Channel Valve is actually a combination of several small valves — each channel with its bowed leaf spring operates individually over a corresponding slot-shaped port. The channel lifts straight up in the guides without flexing; opening is uniform over the full length of the port, giving uniform air velocity without turbulence. The cushioning takes effect when a small volume of air is trapped between the channel and its leaf, causing the channel to float silently to a stop.

Channel Valves are a product of Ingersoll-Rand's own valve research and manufacturing departments, and constitute only one of the quality features which have given the I-R compressor line its reputation for excellence. For more information about compressors for any service, from ½ to 7500 hp, call your I-R representative.

ESH
20 to 150 hp.

PHE
75 and 100 hp.

XLE
125 to 350 hp.

PRE
400 to 2000 hp.

XPV
200 to 1500 hp.

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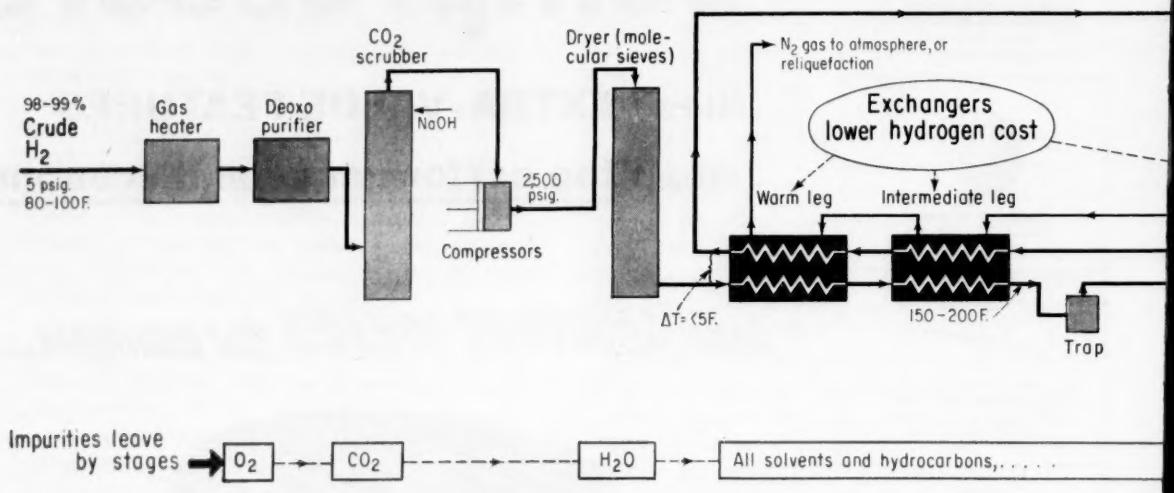


Small Volume Pure Hydrogen at Bulk Cost

Here's an economical new way to get pure hydrogen. Produced by low temperature techniques, cost of this hydrogen equals that of electrolytic product.

Processors with a need for ultra-pure hydrogen—and there are increasing numbers of them—have a stake in Van de Mark Chemical's plant located adjacent to Esso's Bayway refinery, Linden, N. J. In this plant a new low-temperature purification technique is going through its initial paces turning out 99.99% hydrogen (less than 75 ppm. hydrocarbons, less than 10 ppm. CO) from a complex refinery offgas*—at a price competitive with electrolytic hydrogen.

▶ **Neat Trick**—The trick is not, mind you, to turn out a pure product from an impure feed. The trick is to do it in relatively small volume for a reasonable capital investment and at bulk prices.

This trick the new process turns neatly, according to its backers. Van de Mark's hydrogen capacity is 15 million scf./mo. for a plant costing $200,000-250,000 with an energy demand of about 200 hp. (In the compressed gas business, capacities of 50-200 million scf./mo. are usually the rule.)

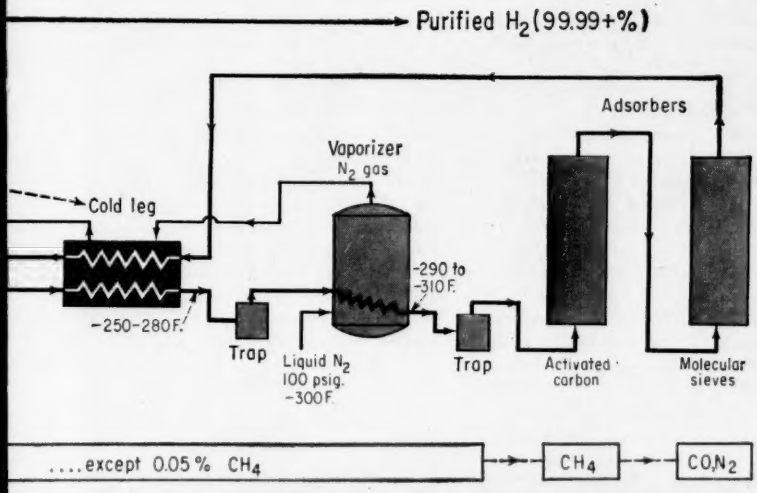
Van de Mark's hydrogen customer, Linde, seems well pleased both as to price and quality, says the stuff is as good, if not better, than electrolytic hydrogen available in the same area.

▶ **Fosters Independence**—More widespread availability of high-grade hydrogen in bulk is the big promise implicit in this development. Users of very pure hydrogen have had to rely on cylinder or trailer supplies unless they were fortunate enough to be near an electrochemical plant.

Van de Mark is prepared to build a plant at the point of use and sell you hydrogen wholesale. If you prefer to own the generating plant, then you work alone with Chemical Design, Inc., Lockport, N. Y., which owns the process and will design a plant for you.

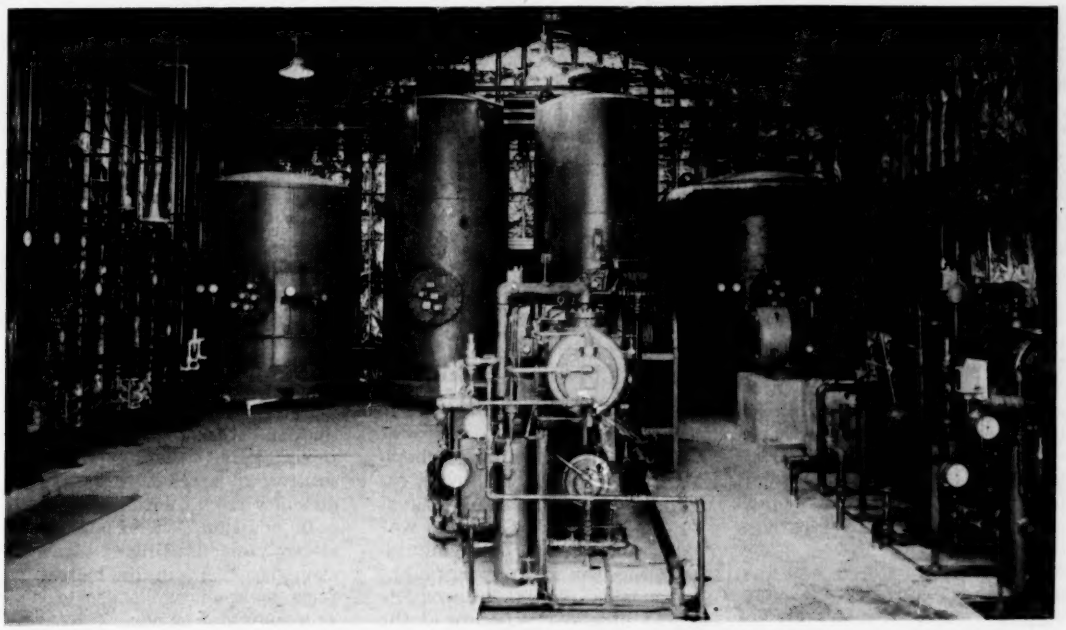
Hydrogen customers in the metallurgical field will get a package setup involving Selas Corp.'s complete hydrogen generation facility, starting from

* From dehydrogenation of isopropanol and sec-butanol to produce acetone and methylethylketone, respectively. Esso's offgas assays 98-99% hydrogen.



How Typical Crude Feed Compares With Pure Product

Component	Crude Feed Mole %, Vol.	Pure Product Mole %, Vol.
MEK	0.06	Nil
Sec. butanol	0.25	Nil
H_2O	saturated	Nil
CO_2	0.006	Nil
O_2	0.01	Nil
N_2	0.03	Nil
CO	0.03	<10 ppm.
C_1–C_4 and up	0.314	<75 ppm.
H_2	99.3	99.99+%



COLD section of hydrogen purification plant consists of two identical systems operating in parallel. In foreground, compressors; center background, adsorbers; sides background, heat exchangers enclosed in vessels.

natural gas, which will supply crude hydrogen to Chemical Design's purification unit.

▶**Unique Exchangers**—For the blend of high quality at low cost, credit uniquely designed heat exchangers where indirect cooling with liquid nitrogen fractionally condenses impurities in the feed. Says Chemical Design's Jim Meyer, "We can play a tune (with temperature levels) on these exchangers like a piano to compensate for different feeds."

About all that's been disclosed about exchanger configuration is that they consist of ¼-in. copper tubes in which hydrogen is cooled by gaseous nitrogen at −300 F. By operating at 2,500 psi. (hydrogen side) Meyer can squeeze 15 million scf./mo. of product out of an

effective throughput of only 2 cfm. and, consequently, modest-sized equipment.

The small tubes afford unusually high heat transfer rates ($U = 500$), yet are not prone to frequent plugging, thanks to close temperature control all along the line and careful removal of impurities from the system via condensation and selective adsorption.

▶**Minimize Heat Leak**—Thermal economy is assured by holding heat leak—always rough in a small low-temperature plant—to 1,200-2,000 Btu./hr., and by keeping the temperature differential less than 5 F. at the warm end of the heat exchangers.

Meyer attributes heat-leak control to vacuum insulation with colloidal silica. Although premium-priced compared with perlite (70¢/lb. vs. 12¢/lb.), silica proves to be a far more efficient heat barrier at easily attained vacuums of 10 mm. To tap perlite's insulating potential means going to vacuums in the micron range—with all their attendant problems.

▶**Adsorption Important, Too**—Although much of the critical work of impurity removal is carried out via fractional condensation in the heat exchangers, selective adsorption also lends a hand.

Molecular sieves dry compressed hydrogen feed to very low dew points before reaching the exchangers. After being cooled to about −300 F., hydrogen feed then passes through beds of activated carbon and molecular sieves for removal of last traces of impurities prior to running against feed hydrogen in order to recover refrigeration.

▶**Step by Step**—Here's how the over-all process works, step by step.

Impure hydrogen enters Van de Mark Chemical's plant at ambient temperatures and 5 psig. There it's heated and treated in a catalytic unit to rid it of oxygen (which combines with the hydrogen to form water).

Feed hydrogen then passes through a scrubber where caustic solution washes out carbon dioxide. Next comes compression to 2,500 psi., followed by drying to around −100 F. dew point in towers packed with molecular sieves.

Now the dry hydrogen moves through a series of four heat exchangers. In the first three, it runs countercurrent to purified, −300F. hydrogen and nitrogen gases while in the fourth it runs against boiling liquid nitrogen. Traps following the second, third and fourth units remove condensed liquids.

Hydrogen feed leaving the first two exchangers is in the range of −150 to −200 F.; after the third it is at −250 to −280 F.

The fourth heat exchanger—merely a pipe submerged in boiling nitrogen—takes feed hydrogen down to about −300 F. At this temperature, hydrogen runs through adsorbent beds of activated carbon for removal of last 0.05% trace of methane and through molecular sieves which pick up carbon monoxide and nitrogen.

Purified hydrogen moves back through the tubular heat exchangers against incoming hydrogen, discharging at a temperature less than 5 deg. F. below that of the incoming gas.

Nitrogen vaporized in the fourth exchanger helps out in tubular exchangers to compensate for heat losses.

Soviet Chemical Exhibit: More Show Than Chemicals

From the standpoint of chemical technology, the Soviet exhibition which closed on August 10 at New York's Coliseum was a disappointment. Most significant was the minor role played by chemical plants and products in the displays. Visitors at the exhibition realized why the Soviet Union is so anxious to import Western know-how: Soviet achievement in the chemical field did not seem to match the accomplishments in electronics, medical research, heavy machinery or construction.

Most impressive chemical display was a huge poster declaring that Soviet chemical output would be tripled by 1965. But this bold statement was not borne out by accompanying exhibits. There was one small display of plastic molding powders labeled merely "high-pressure polyethylene," "low-pressure polyethylene" and "polytetrafluoro-ethylene." Nearby were a half-dozen hefty PVC valves. Despite this skimpy display, however, the Soviets did make extensive use of plastics in the construction of other exhibits.

The one chemical plant model—a butadiene plant—showed fine workmanship. But conspicuous by their absence in this area was the lack of any photographs of commercial installations such as one found by the impressive construction exhibit.

Membrane Replaces Fuel Cell Electrolyte

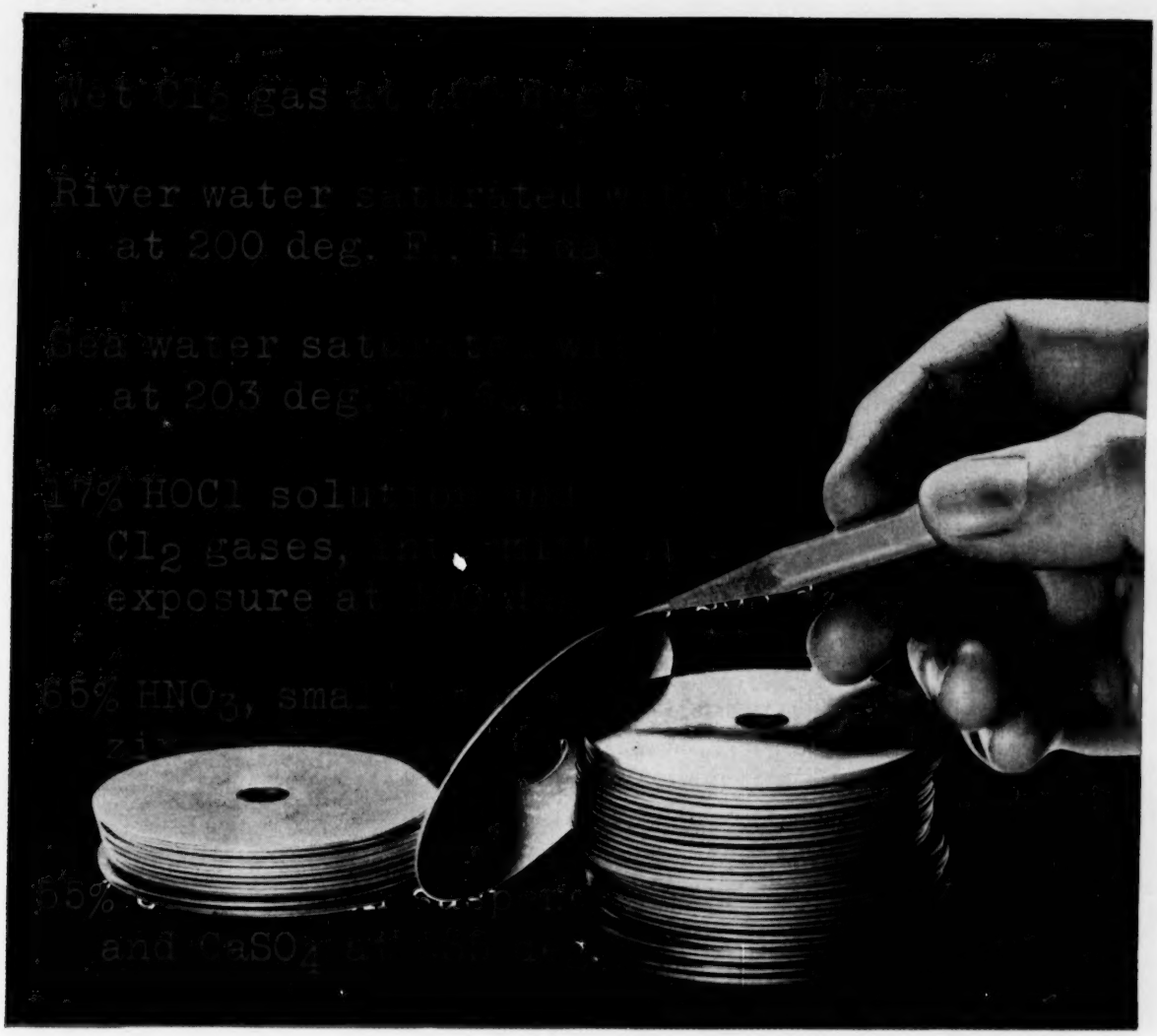
An ion exchange membrane, acting as a solid electrolyte, makes possible a very compact structure for a new fuel cell developed at General Electric's Research Laboratory. (For other cells, see *Chem. Eng.*, Dec. 1957, pp. 157-8.) In turn, power densities in the range of 1-2 kw./cu. ft. have been calculated from recent data.

With the solid electrolyte, GE attains built-in controls for maintaining electrolyte concentration and water balance. In contrast to aqueous electrolytes, ions in the membrane are locked in and cannot be leached from the cell. Also, these membranes reject water when they reach saturation so that there is no difficulty from dilution.

In addition, use of an acidic electrolyte consisting of a cation exchange resin in its hydrogen form makes possible use of air as a source of oxygen.

Hollow interior of 3-in. dia. plastic cell, 1½ in. thick, is divided into two chambers by plastic membrane which has an electrode in contact with each side. At one electrode, hydrogen molecules give up electrons which travel through external circuit to other electrode. Positively charged hydrogen ion migrates through membrane to other electrode to combine with oxygen and electrons, forming water.

TITANIUM...COMING OF AGE!



One of the most comprehensive tests undertaken confirms titanium's outstanding corrosion resistance

Encouraged by increasing availability (and lowering costs) of titanium, more and more designers of process industry equipment are testing and applying its unique corrosion resistance and other properties.

One of the most extensive evaluations ever made, with actual chemical plant exposures, was a seven-plant series of tests by Columbia-Southern Chemical Corporation. The tests, covering 2300 specimens of 40 materials involved many environments.

Test results led Columbia-Southern to broaden use of titanium in actual equipment such as valves, heating coils, nitric acid reboilers... in their most corrosive media. In service for nearly a year, the equipment has confirmed the earlier findings.

The detailed results of this test are well worth your study. Write for your copy of a summary report today.

Union Carbide Metals Company,
Division of Union Carbide Corporation,
30 East 42nd Street, New York 17, N.Y.
In Canada—
Union Carbide Canada Limited, Toronto

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Electromet *Brand Ferroalloys and other Metallurgical Products*

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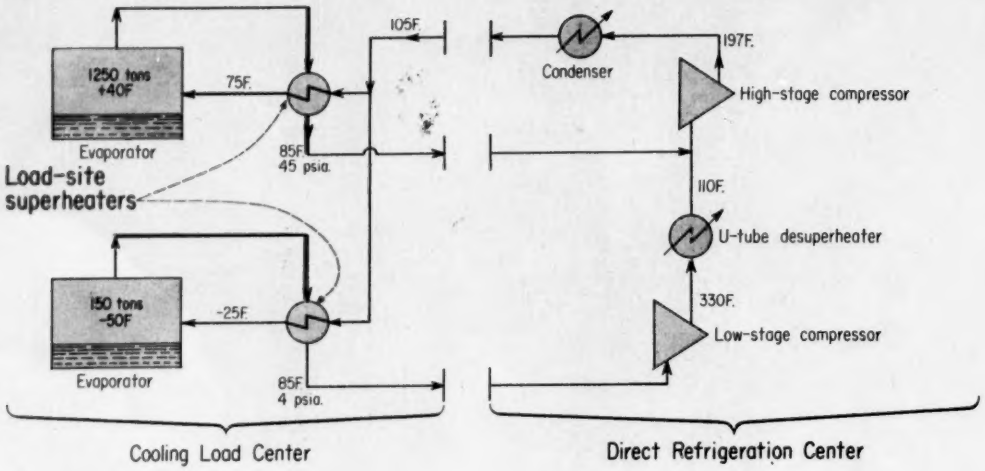


Load Site Superheating Simplifies Cooling

- **Eliminates need for miles of piping insulation.**
- **Boosts refrigeration effect at coolers.**
- **Bypasses low-temperature piping codes.**
- **Cuts required pipeline length by 29%.**

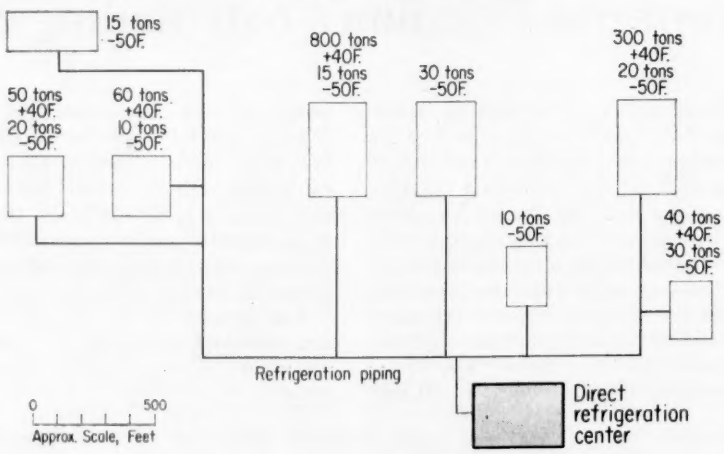
If you ever have to design a process that furnishes hundreds of tons of refrigeration to each of eight load sites widely scattered at distances up to a half mile apart, you'll have a problem on your hands.

And if the plans dictate that required refrigeration be divided between two different temperature levels for most of these sites, be prepared to do a real fancy engineering job.

Catalytic Construction Co. and Olin Mathieson Chemical Corp. faced such a situation during the design of Olin's hydroboron fuel plant near Niagara Falls, N. Y. They solved the problem by building a direct expansion refrigeration system utilizing a centrally located

(*Continued on p. 66*)

Dispersed Areas Served by **Direct Refrigeration**



Announcing the new GLAS-COL Desiccator heating mantle

. . . it assures even heating which minimizes chance of thermal strain to glass vessels.

. . . it provides an effective shield for personnel in the rare instances when glass vessels do collapse.

This new, aluminum-housed electric heating mantle is specifically designed for heating heavy-walled vessels in which vacuums must be created to permit the drying of various samples.

As a result of the high pressure due to conditions of high vacuum, heavy-walled vessels occasionally collapse. When such accidents happen, the Glas-Col aluminum-housed heating mantles provide a very effective shield to protect personnel from flying glass and chemicals.

Glas-Col mantles have been used to heat desiccators for several years . . . with *complete* success.

Glas-Col Desiccator mantles are priced from $45.00 to $57.00

Catalog No.	Desiccator Flange Diameter	Watts (115 Volts)	Price
M-200	160 mm	330	$45.00
M-202	200 mm	380	57.00
M-204	250 mm	380	57.00

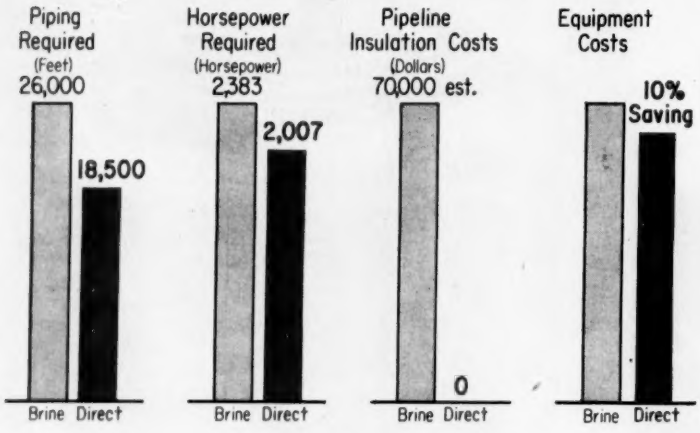
Glas-Col Apparatus Company
Dept. CR, 711 Hulman Street, Terre Haute, Indiana
. . . the world's largest manufacturer of heating mantles

U.S. Patents 2,282,078 2,739,220 2,231,506 and 2,739,221

GLAS-COL ELECTRIC HEATING MANTLES

A complete line for laboratory, pilot plant, and chemical process heating applications.

How Direct Refrigeration Beat Brine Cooling



compressor building and load-site evaporators and superheaters.

Most interesting system feature is the complete absence of insulation on the many miles of suction piping running between the many evaporators and the engine house.

▶ **Alternate Routes**—For safety reasons, operating areas in the high-energy fuel plant had to be separated by considerable distances. Five of the eight areas required refrigeration at two temperature levels, −50 F. and 40 F. Process studies established an over-all heat balance of about 150 tons at the −50 F. level and 1,250 tons at 40 F.

Cost of electricity and water distribution, as well as the difficulty of maintenance in hazardous and restricted areas, ruled out local compressor equipment at the various loads. A central refrigeration system was an obvious necessity.

According to Application Engineer R. A. Dorwart, York Div., Borg-Warner Corp., first thoughts on the central system were given to the use of brine circulation via two networks of piping, one for each temperature level. However, with the low temperatures involved, costly line materials would have been required by the piping codes. Also, heavy insulation of the long supply and return brine lines, needed to minimize heat gains, would have hiked cost to an unwarranted level.

Additional study resulted in the decision for a direct system, with expansion and superheating right at the load sites.

▶ **Superheating Pays Off** — As the plant now stands, liquefied Refrigerant-12 at 105 F. leaves the compressor building and passes through uninsulated piping to each product area. Flow splits at areas with dual load temperatures.

Before evaporating in the individual coolers, the liquid enters special exchangers where it superheats the cold, gaseous refrigerant returning to the suction side of the compressors. Temperature of the gas rises to 85 F. This step pays off in two ways.

First, the technique of superheating suction gas right at the load avoids low-temperature piping problems and eliminates heat gains; this obviates all suction-line insulation.

Second, this useful exchange ups the available refrigerating effect in the coolers, thus reducing required refrigerant flow rates. Bar graph visually compares the direct and brine routes.

▶ **Dual, Tandem Compressors**—Actually, the central compressor setup consists of two systems, not one. Heart of each system is a tandem (duplex or drive-through) York turbocompressor that handles refrigerant gas from both temperature levels with one 2,500-hp. drive.

Each system is sized for 60% of anticipated maximum load. One system, including all accessory items, is completely steam-powered; the other is completely electric. Such an arrangement provides operating flexibility and adequate temporary capacity to keep the process on line as long as one system is operating. This was a vital consideration because complete shutdown would result in considerable time and expense on subsequent startup.

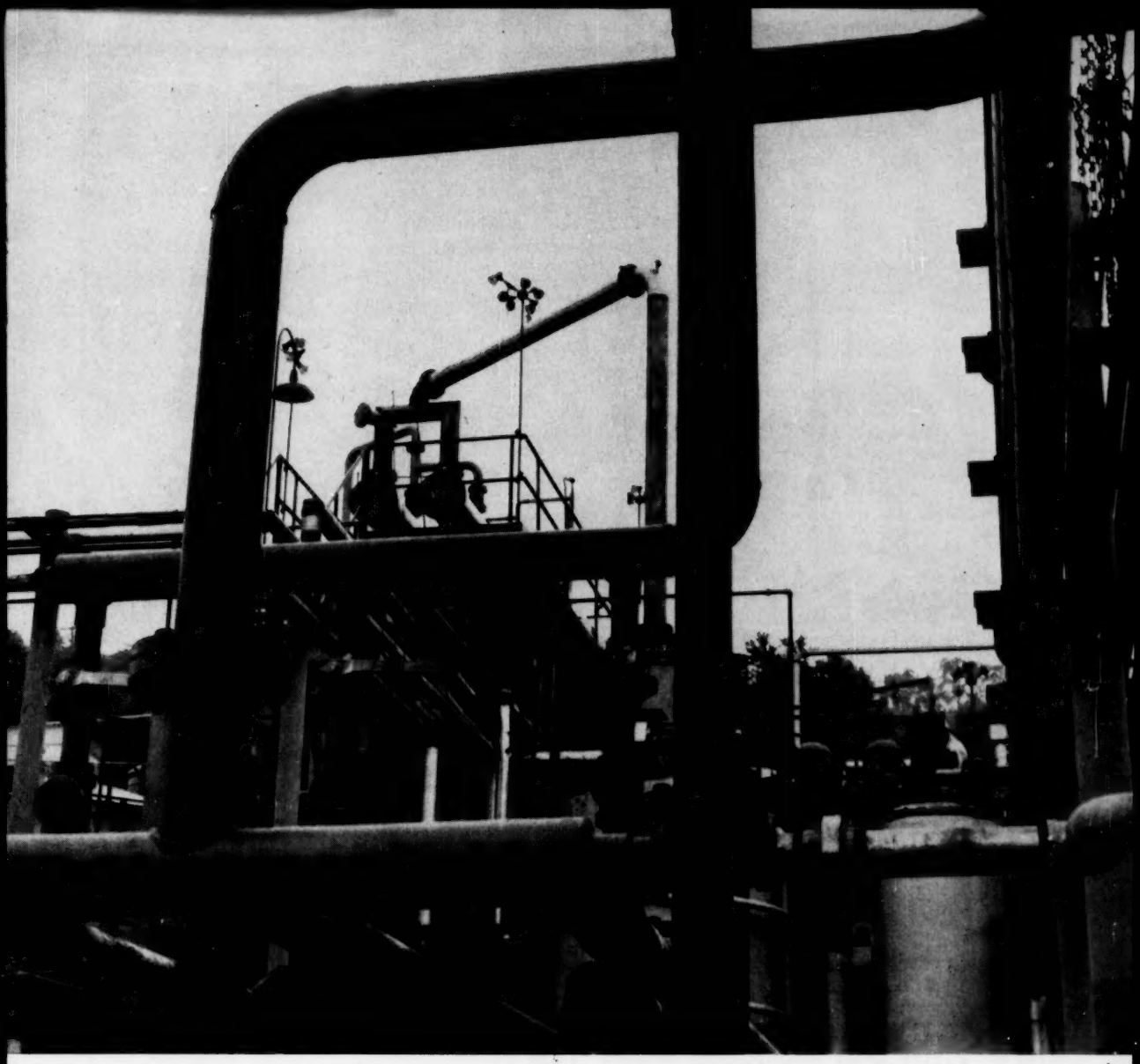
Low stage of each compressor draws on 85-F., 4-psia. gas leaving the −50 F. loads. Discharge from this stage at 46 psia. is water-cooled to 110 F. in the compressor-room desuperheating exchanger.

Desuperheating of the 85 F. gas prior to its entry into the compressors was found to be unwise. A study showed hot compression, with part of the load removed by water at an intermediate stage, to be more efficient.

The streams then join 45-psia. gas from the 40 F. loads, and combined, they flow to the compressors' second stages. Output, condensed at 105 F., is distributed to the eight load sites.

▶ **Spacing Sires Problems**—Because of the extremely long lengths of distribution pipelines, pressure drops are large —in the neighborhood of 20 psi. To offset flashing in the lines before refrigerant reaches the control valves, a pump in the engine room raises liquid pressure 30 psi. above saturation point.

One other interesting aspect of Olin's refrigeration plan is the manner in which they handle cooler maintenance. A portable, skid-mounted, compressor pumpout unit permits servicing on any of the remote evaporators while the balance of the system remains on line. Valving is first arranged to push liquefied refrigerant out of the cooler and back into the liquid line for fast transfer. Then valving is reversed, and the compressor pumps out remaining vapor.



"Stainless Steel reduces material and replacement costs"

reports Mr. William R. Boyles, Plant Manager, Stauffer Chemical Company, Monongahela, Pa.

The Stauffer Chemical Company of New York City is a major producer of industrial and agricultural chemicals. Many of its 52 plants around the country make or process highly corrosive chemical solutions. In the past, equipment at the Chauncey and Monongahela plants had to be replaced about every two years because of corrosion—particularly at pipe joints and threadings. This meant a plant shutdown or a cut in production to make the necessary repairs.

In 1954, after experimenting with other materials, the company decided Stainless Steel was the most suitable metal. It was then used to replace vital parts in equipment. Here are the results at Stauffer's Monongahela plant according to Plant Manager, William R. Boyles: "Stainless Steel has definitely solved most of our problems of equipment replacement. We no longer suffer periodical shutdowns or delays in production because of corroded equipment. Stainless Steel has proven its effectiveness against corrosion. It has saved us time and money. We have had our Stainless Steel equipment in continuous use since the day it was installed—and it's still in excellent condition. In fact, we expect it to last for 15 years—maybe longer."

End corrosion losses in your plant. Build and repair with Stainless Steel. USS Stainless Steel is available through your U. S. Steel representative or your local Steel Service Center.

USS is a registered trademark

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American Steel & Wire—Cleveland
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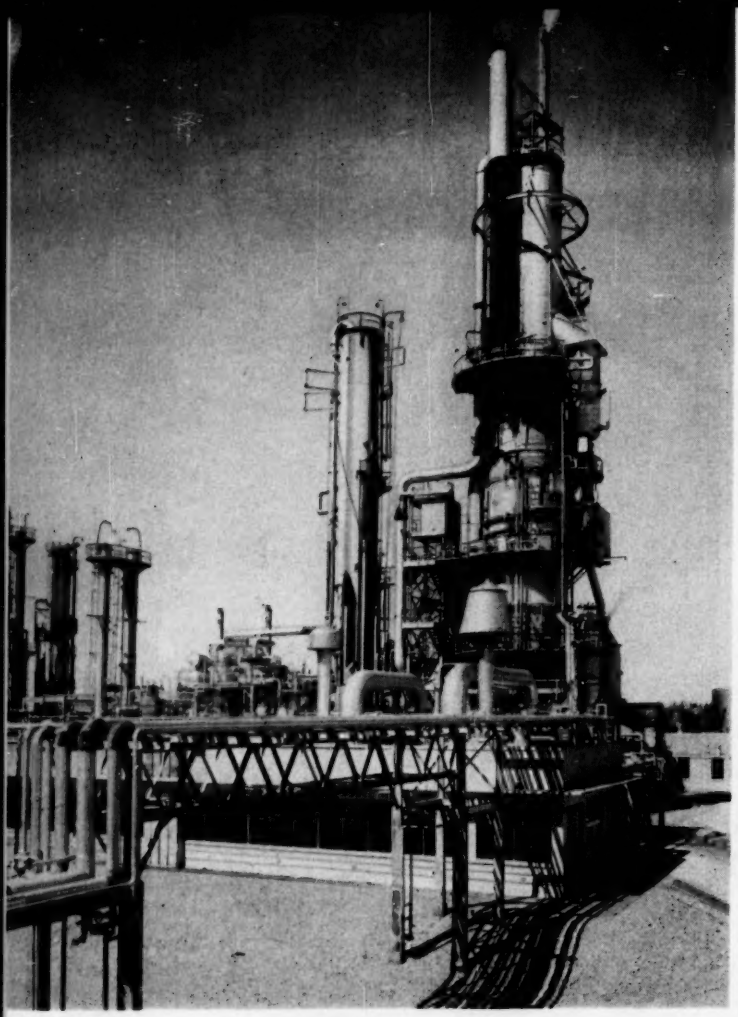
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Supply—Steel Service Centers
United States Steel Export Company

United States Steel

USS



REVAMPED cat cracker now reaches higher conversion level and handles more feed.

Refinery Chews a Bigger Bite of Crude

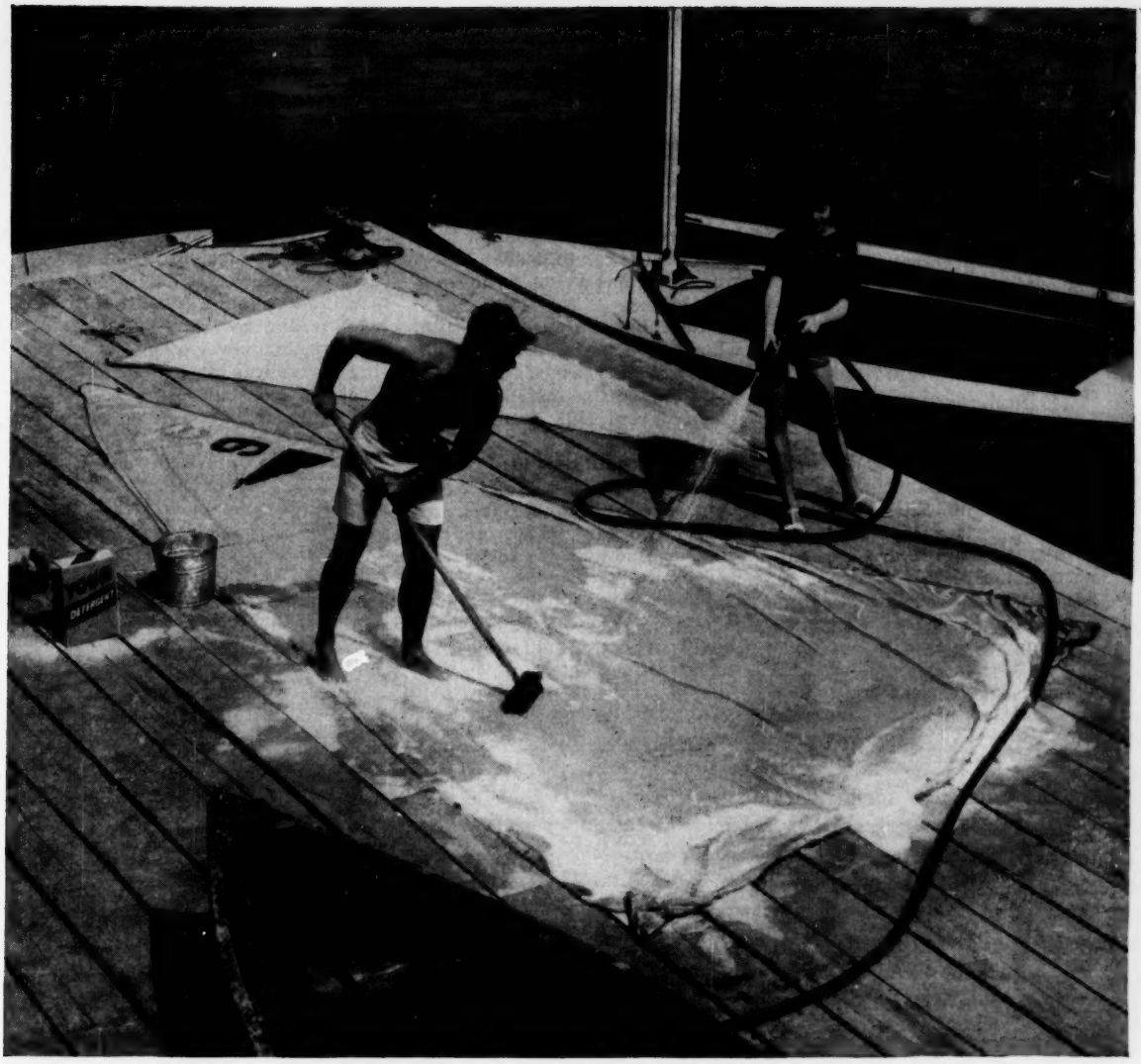
Modernization at La Gloria Oil & Gas Co. has boosted capacity and recovery in cracking and gas concentration, raised over-all refinery efficiency.

More and better products from a barrel of crude has been the petroleum refiner's aim for years. Of late, gasoline has been the refiner's most valuable product. And most important, a refinery must be efficiently modern to keep a competitive edge.

With these aims, La Gloria Oil & Gas Co., wholly owned subsidiary of Texas Eastern Transmission Corp., has now completed a $2-million modernization program at its Tyler, Tex., refinery, concentrating its efforts on the catalytic cracking and gas recovery units. La Gloria has raised throughput and conversion level in cat cracking, has improved recovery of propane and propylene by more than 75%.

Modernization comprised updating of some units and installation of new ones. Engineering and planning were done with a minimum of downtime as a goal. Brown & Root of Houston, Tex., in charge of the program, kept downtime to about 40 days.

▶ **Crack Modern**—Cat cracker, a stack-type with reactor perched atop the regenerator, was built by Universal Oil Products in



To make detergents that sail right through the dirty work!

ENJAY OLEFINS

• TETRAPROPYLENE • TRIPROPYLENE

Cleaning sails . . . cleaning house . . . cleaning almost anything – detergents can do it and do it better than anything else. The basic ingredients in many detergents are Enjay Olefins: Tetrapropylene and Tripropylene. Like all Enjay petrochemicals, Enjay Olefins are known throughout industry for their uniform purity and high quality. Remember: for top-quality detergents, use Enjay Tetrapropylene and Tripropylene.

OIL'S FIRST CENTURY
1859 1959
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WORKING FOR PROGRESS

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PETROCHEMICALS

EXCITING NEW PRODUCTS THROUGH PETRO-CHEMISTRY

ENJAY COMPANY, INC.

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1951 and has been remodeled once since then. Newest changes raise output by 20-25%, lift conversion level (based on fresh feed) from 62% to 74%.

Cracker's catalyst regenerator previously burned about 7,400 lb./hr. of coke when the unit handled 7,250 bbl./day of fresh feed. Now coke-burning capacity is up 39% to about 10,000 lb./hr. with a fresh feed of about 9,800 bbl./day entering cracker.

To help air and oil distribution, new grids have been added —one for air at the bottom of the regenerator, another for oil at the bottom of the reactor vessel.

Operating pressure in the unit has been raised from 17 to 28 psig. Spent catalyst recovery has been improved by replacing the side stripper with one having 1½-ft. greater diameter. And diameter of the riser line, which lifts catalyst from regenerator to reactor, has been increased from 24 to 30 in. I.D.

Other changes: An additional turboblower for regenerator air supply, another waste-heat steam generator which uses heat from the main column bottoms, a silencer to deaden noise when flue gas vents to the atmosphere.

▶**Fractionator Improved** — La Gloria boosted operating efficiency of the cracker's fractionation system by installing new trays. From this fractionator four main cuts go to storage or further treating — heavy and light cycle oils (to storage), catalytic naphtha (to treating plant), overhead which supplies cat gasoline and gas to gas recovery unit.

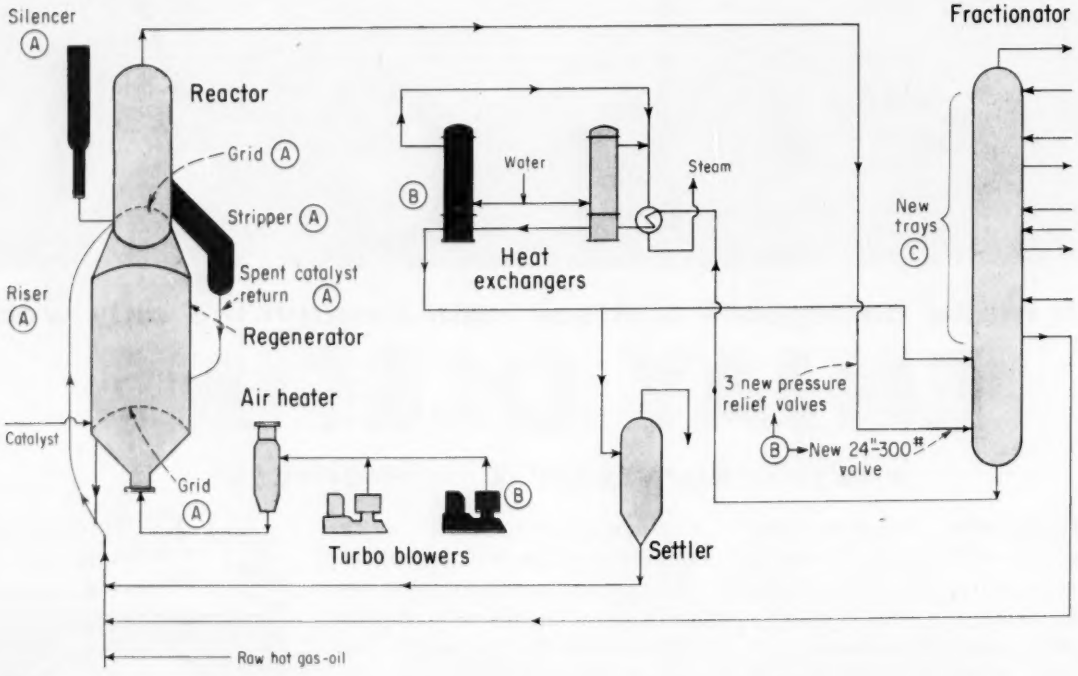
Fractionator's top section now has 17 dual-downflow bubble-cap trays. Middle and bottom sections have new type Duoflo tray designed by Fractionation Research Institute. This last section has highest liquid handling capacity.

▶**More Gas Recovered** — New gas concentration unit has boosted recovery of propane and propylene from 55% to 92%.

New, more efficient units are: primary and secondary absorbers, stripper, debutanizer, coolers and receivers.

With this new system, operating pressures have been increased from 85 psig. to 200 psig. La Gloria converted three existing single-stage, reciprocating compressors to two-stage operation with low-pressure and high-pressure sides. To these the company added two new 350-hp., two-stage compressors.

Design capacity of the new unit can handle gases from the entire refinery. There is less product loss to the refinery fuel-gas system, more complete use of crude to the refinery.



These Changes Lifted Output and Performance

- (A) New catalyst grids and lines to increase flows
- (B) Additional auxiliaries to match higher throughput
- (C) New tower internals for better efficiency

An Important Message
ABOUT TANTALUM EQUIPMENT

AND WHAT TO EXPECT FROM FANSTEEL

WORLD'S LARGEST TANTALUM BAYONET HEATER

Since 1937, when Fansteel produced the first tantalum bayonet heater, many thousands, of varied sizes and shapes, have been put into service. Their record of performance (over twenty years of continuous duty is not unusual) is truly outstanding.

The unit illustrated is the largest tantalum bayonet heater ever produced, *thus far*. Made up of 36 tantalum tubes, 1½" dia. x 72", it provides 75 sq. ft. of heat transfer surface. It was designed for use with 160 psig steam to heat a nitric acid mixture.

Samples of metals for testing are available upon request; arrangements can be made for the loan of certain equipment for pilot operations or heat transfer studies.

More tantalum equipment engineered and fabricated by Fansteel is in use today in a greater diversity of chemical processes than at any time in history. This equipment includes heat exchangers, evaporators, stills, condensers, coils, bayonet heaters, instrument protection—all used under extremely corrosive conditions where long equipment life, freedom from product contaminations and undesirable side reactions make the use of tantalum a necessity.

Fansteel is properly proud of this contribution to the chemical industries, a contribution, indeed, which has been recognized by several national awards.

However, it is not enough merely to attain a position of leadership; it must be kept. And Fansteel has taken these steps to be of greater service to our chemical industry customers:

Tantalum Plentifully Available. As you read this, the tantalum production at both our North Chicago and Muskogee, Oklahoma plants is at record levels. Short of total war, there will always be an ample supply of tantalum for chemical equipment.

Improved Delivery Service. New equipment has been added in our fabrication shops, particularly equipment for improved welding. Tapered tantalum condensers (Cat. No. D-4538) are presently stocked for immediate delivery. A stock of tantalum bayonet heaters, in several sizes, will also be available soon.

One Integrated Responsibility. Fansteel is the one supplier of tantalum equipment who performs the entire job—produces the metal from the ore, engineers the application, designs and builds the suitable equipment. With Fansteel, there can be no divided responsibility.

Other Materials of Construction. Fansteel is fabricating equipment from other materials of construction, such as columbium, molybdenum, tungsten, zirconium and titanium. While these metals are not as highly resistant to corrosion as tantalum, they all have desirable properties for chemical processes applications.

Engineering and Design. Fansteel is always ready to undertake the task of converting your problem into a reliable piece of equipment, when it comes within the scope of our materials and experience. This means that we will design and fabricate the equipment and, if desired, assist in installation.

SINCERELY,

Fred N. Briggs
PRESIDENT

Address your inquiries to Equipment Department, Metals Fabrication Division

G592

FANSTEEL METALLURGICAL CORPORATION
North Chicago, Illinois, U.S.A.

FANSTEEL

"Thermos Bottle" Truck Carries Liquid Ethylene

Liquid ethylene at —155 F. is now being shipped for the first time on this continent via tank truck. Imperial Oil is using two tank trucks, like the one pictured above, to ship liquid ethylene from Sarnia, Ont., to Union Carbide Chemicals at Montreal East, 536 miles away (*Chem. Eng.*, July 27, 1959, p. 53). Imperial also ships liquid ethylene to a Buffalo plant. Tanks are covered with about 9 in. of expanded polystyrene insulation.

Japanese Reveal New Isoprene Processes

Tucked into the verbal comments presented at the recent World Petroleum Congress in New York was the revelation of two new processes for making isoprene, now being pilot-planted in Japan. Processes were revealed at a technical session where the isoprene process of Institut Francais du Petrole was described (see (*Chem. Eng.*, June 1, 1959, pp. 35-38).

One route was developed by Tozo Amemiya of Japan's Resources Research Institute at Kawaguchi near Tokyo. It involves reaction of propylene and ethylene over an organometallic catalyst at conditions under 390 F. and 725 psi., followed by catalytic dehydrogenation to isoprene.

Process has been piloted (about 50-60 lb./day) since late last year and, according to Amemiya, looks promising enough so that Japanese firms may help finance a larger operation. No cost details are available yet, but Amemiya hopes that a polyisoprene made from his product would cost only "a little bit more" than styrene-butadiene rubber.

The other route, operating on a 100-lb./day scale since early last year, reacts acetylene and acetone in a modification of the classical method of Weizmann. However, developer SyuKambara of Tokyo Technical College uses a new type of catalyst and more moderate operating conditions.

NEWS BRIEFS

N-Butyl lithium: Lithium Corp. of America has started up its commercial n-butyl lithium plant in Minneapolis, Minn., with initial production in excess of 1,000 lb./mo. Initial price is about $75/lb., but is expected to drop in the next few years to $40-$50/lb.

Polyphenyl ethers: Dow Chemical will produce 5,000 lb. of two polyphenyl ethers for the Air Force for evaluation as high-temperature radiation-resistant lubricants. The ethers, bis(phenoxyphenyl) ether and bis(phenoxyphenoxy) benzene are useful from 600 F. to 20 F. and 40 F., respectively, in an oxidizing environment, and up to 900 F. in a nonoxidizing environment. Pilot-plant capacity allows production of small quantities for industrial applications.

Supercritical gases: E. U. Franck, of Goettingen University, recently received an award for his work on supercritical gases. These high-pressure gases can serve as solvents and have been used in making artificial quartz crystals. Franck subjected steam to temperatures and pressures up to 750 C. and 2,000 atm., found that steam densities over as little as 0.5 gm./cc. almost completely dissociate dissolved substances.

Shale oil: Denver Research Institute is now operating its revamped shale-oil pilot plant at Denver, Colo., on a four-month test run. Plant, operated for Oil Shale Corp., Carson City, Nev., is processing 1 ton/hr. of shale to test Aspeco process (*Chem. Eng.*, Sept. 8, 1958, p. 70).

Atomic power: Commonwealth Edison's Dresden nuclear power station, being built on the Illinois waterway 50 mi. southwest of Chicago, is now about 70% complete and is expected to be in operation some six months ahead of the original scheduled completion date of Dec. 7, 1960. Station, with capacity of 180,000 kw., will be the first full-scale, private U. S. plant.

NEW AMESTEAM GENERATOR

MODEL AA

NEW Lower Cost

NEW Oil Burner

NEW Gas Burner

NEW Compactness

NEW Lower Fuel Costs

NEW Lower Maintenance Costs

NEW More Convenient Controls

. . . OLD AMES DEPENDABILITY

The **NEW** Model AA AMESTEAM GENERATOR offers the ultimate in steam generating efficiency and reliability.

The **NEW**ly designed low pressure air atomizing oil burner will cleanly and uniformly burn all commercial grades of oil — #4 with little or no preheat — for more efficient, economical firing. Since electric pumping and preheat loads are lower, power costs are greatly reduced. For gas firing the **NEW** ring type burner provides a more uniform flame pattern for cleaner, more efficient combustion.

All Model AA AMESTEAM GENERATORS are designed to operate at top efficiency over a modulation range of 20% to 100% of rating.

The Model AA incorporates Ames' time-proven 3-pass concentric tube design, single one-piece baffle and one-piece flue covers. Easier access is provided for inspection and servicing. The **NEW** ultra-compact design simplifies positioning and installation. All units are factory-assembled and fire-tested.

Before you buy a package boiler get the facts on the all **NEW** Model AA AMESTEAM GENERATOR.

ABC CHEMICAL CO.

Income Statement, Dec. 31, 1958

Without Allowance for Inflation	
Income before provision for income taxes	$40,000,000
Less income tax	19,000,000
Net income	21,000,000
Less common stock dividend	5,000,000
Retained earnings for period	**$16,000,000**

With Allowance for Inflation	
Income before provision for income taxes and inflation	$40,000,000
Less income tax	19,000,000
Net income before allowance for inflation	21,000,000
Less allowance for inflation	15,000,000
Net income after allowance for inflation	6,000,000
Less common stock dividends	5,000,000
Retained earnings for period	$1,000,000

Don't Forget to Allow for Inflation

Inflation is taking a cruel bite of corporate earnings. But do you know how much? Here's a way to take inflation's measure.

F. C. Jelen, 1920 Glenwood Ave., Syracuse 4, N. Y.

Inflation is an expense and should be recognized as such. It should be allocated to operations over the year by some accounting procedure. The time to start allowing for the expense of inflation is now.

There are many reasons for using an allowance for inflation account. Treated as an expense, it will assist a company in charging properly for its goods and services. Its appearance on the income statement (see table above) and on the balance sheet (see p. 80) is essential to their proper interpretation.

The allowance for inflation should be there so that all may see that profits made without this consideration are a mirage —aptly called "phantom" profits.

A firm which starts computing an allowance for inflation will know the true cost of inflation and have exact figures for publicizing it to others.

▶ **Change in Plans**—If the company had been making an allowance for inflation in the past and been fully aware of inflation's cost, much of its policy might have been different. The company itself, in fact, might have been significantly different from what it now is.

Certain products, which seemed sufficiently profitable when no allowance for inflation was taken into account, might have been dropped. Opportunities to borrow funds in the past may have been neglected under the mistaken attitude that retained earnings were sufficient to keep up with needed expansion.

Of course an allowance for inflation does not in itself create anything for expansion. It merely prevents a contraction. When inflation exists the only funds generated internally that are available for expansion are those retained after an allowance for inflation has been made (see table above).

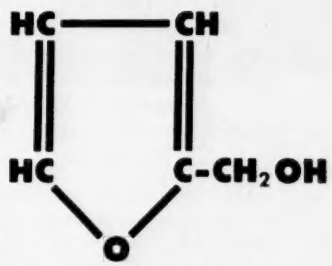
▶ **Is It Inflationary?** — Critics might say the allowance for inflation is in itself inflationary,

One of a series on

BENEFITS OF QO® FURFURYL ALCOHOL

Furfuryl Alcohol (FA®) Resins:

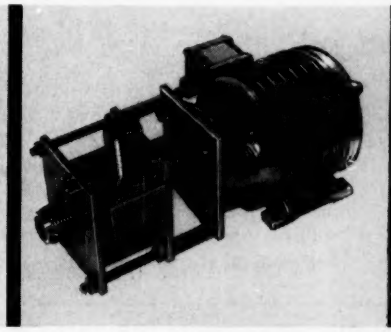
- Provide fast cure with little or no external heat
- Are infusible, insoluble polymers when cured
- Have low porosity
- Are inert to chemical attack
- Have high tensile strength and high heat resistance



Furfuryl Alcohol

Typical Uses for FA® Resins . . .

FA resins are used to manufacture glass or asbestos reinforced acid and alkaline resistant pipe and duct.



Chemically inert vessels, valves and parts are cast of FA resin.

Room temperature setting corrosion resistant, resinous mortars are used to set tile and glazed brick exposed to chemicals or fumes.

The resins are also used as a wetting agent and binders for sand, asbestos, glass and other materials and as impregnants for porous materials.

How you can benefit

The above material represents only one area of use for FA. For information about other uses, physical data and chemistry write for Bulletin 205.

The Quaker Oats Company manufactures QO furfuryl alcohol—not FA resins.

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In Europe:
Quaker Oats-Graanproducten N. V., Rotterdam, The Netherlands;
Quaker Oats (France) S. A., 3, Rue Pillet-Will, Paris IX, France;
A/S "Ota", Copenhagen, S. Denmark

In Australia:
Swift & Company, Ltd., Sydney

In Japan:
F. Kanematsu & Company, Ltd., Tokyo

How to Express Allowance for Inflation

Allowance for inflation should be in such a form that it can be calculated on a year-to-year basis, and should keep in step with inflation at all times.

First Year

Suppose a single asset costing A_o is purchased at a time when the cost index for this asset is C_o. One year later when the cost index is C_1, the cost of the asset is A_1. The relationship between the costs is:

$$A_1 = A_o C_1/C_o \qquad (1)$$

The added cost due to inflation in the first year—the allowance for inflation—is I_1, which is expressed as:

$$I_1 = A_1 - A_o \qquad (2)$$

Substituting the value for A_1 from (1) in (2) we have:

$$I_1 = A_o(C_1 - C_o)/C_o \qquad (3)$$

Second Year

Now compute the allowance for inflation, I_2, for the second year. At the end of the second year a replacement asset costs:

$$A_2 = A_1 C_2/C_1 \qquad (4)$$

where C_2 is the cost index at the end of the same year. Now for this year:

$$I_2 = A_2 - A_1 \qquad (5)$$

and, substituting as before, we find:

$$I_2 = A_1(C_2 - C_1)/C_1 \qquad (6)$$

Any Year

By comparing (6) with (3) it is obvious that the general relationship for the x-th year is:

$$I_x = A_{x-1}(C_x - C_{x-1})/C_{x-1} \qquad (7)$$

Year Ahead

Equation (7) gives the allowance for inflation at the end of the year and cannot be determined exactly until the cost index becomes known. The allowance for inflation can be forecast, however, by using indexes for the previous year. Thus (7) becomes:

$$I_x' = A_{x-1}(C_{x-1} - C_{x-2})/C_{x-2} \qquad (8)$$

Future Years

Here I_x' designates allowance for inflation for the x-th year but available for calculation at the beginning of the year. C_{x-1} is the index prevailing at the outset of the x-th year, with C_{x-2} the index prevailing at the beginning of the previous year.

---

but this is not true. The concept of an allowance for inflation merely offers a method for computing exactly the expense caused by inflation. Inflation is not caused or enhanced by merely computing its cost. The allowance for inflation is a measure and a consequence of inflation and not its cause.

Corporations and businesses are generally organized on a perpetual basis. The physical assets they use, however, must be replaced eventually. Hence, it is necessary that provision be made for some kind of replacement.

▶ **Replace in Kind**—Because of inflation an equivalent* replacement will cost more than the original, often much more. A depreciation allowance, which repays only the original cost, will be insufficient to pay for the replacement. Something extra is needed, rising entirely from the existence of inflation—the allowance for inflation. (For derivation of equations, see above.)

▶ **Depreciation No Answer** — What is needed now is not a new concept of depreciation but a bold recognition of inflation.

Industry and others can establish allowance for inflation as an expense though the government does not now recognize it for tax purposes. The next step will be to persuade the government to accept an established expense as a tax deduction.

An extra allowance for depreciation, on the other hand, is more likely to be associated with the replacement problem only—and with replacement of fixed physical assets, at that. There will be difficulties in practice if an asset is not replaced in kind (see footnote this page), and this applies to many assets.

The allowance for inflation is not concerned with whether the replacement is made in kind—or whether it is made at all.

An extra allowance for depreciation can be connected only with such assets as can be depreciated. The allowance for inflation embraces all assets that need attention because of inflation.

▶ **Regardless of Taxes**—The inflation allowance is not changed in amount even if tax concessions are made under the principle of an extra allowance for depreciation. Such concessions merely make it easier to meet the obligations of the allowance for inflation account.

Regardless of the tax situation, a balance sheet can only be interpreted properly when an allowance for inflation is included (see sample calculation, p. 78).

An inflation allowance should appear on the income statement. The example on p. 74, which assumes an allowance of $15 million for the current year, shows a significant difference in the retained earnings.

▶ **Not What They Seem** — Real earnings for the period were only $6 million. After paying out $5 million in stock dividends only $1 million was retained as an amount available for expansion.

Now, how do we measure an allowance for inflation quantitatively? Equation (7) above says the allowance for inflation for the x-th year is obtained from the asset value at the beginning of the x-th year and a factor which is determined only by cost indexes for the beginning and the end of the x-th year.

This equation embraces two important considerations: allowance for inflation is independent of the manner in which

*The adjective "equivalent" is a most essential one. Replacement plant and equipment are invariably more costly than their predecessors, not only because of inflation but because they are inevitably different, embodying expansion and improvements, both technological and social. They should cost more, whether inflation exists or not. An allowance for the latter is not intended to buy improvement or expansion; this is the job for retained earnings, new capitalization or debt. An allowance for inflation purports only to replace in kind.

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$BF_3 \cdot C_2H_5NH_2$ Crystalline solid, m. p. 89°C.

This and other amine complexes of BF_3 find use in elevated temperature curing of epoxy and other types of resins. By dissociating at elevated temperature by the follow reaction:

$$BF_3RNH_2 \rightarrow BF_3 + RNH_2$$

the release of BF_3 can be controlled, allowing control of the cure. These materials are suitable for anhydrous systems.

ZINC FLUOBORATE, 40% SOLUTION, $Zn(BF_4)_2$

used for curing resins on cloth to achieve "wash and wear" finishes. Here, again, the activity is due to release of BF_3 at elevated temperatures.

$$Zn(BF_4)_2 \rightarrow 2BF_3 + ZnF_2$$

Useful for emulsion applications that will be followed by heat curing.

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Acetamide

ALIPHATIC AND ALICYCLIC OXYGEN COMPLEXES

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Ethanol
Tetrahydrofuran

AROMATIC N COMPLEXES

Pyridine
Aniline

AROMATIC OXY COMPLEXES

Phenol

HARSHAW

The Harshaw Chemical Co.

depreciation is taken—it is influenced only by the course of inflation; and Eq. (7) uses a moving base for the asset value, i.e., the asset value changes from year to year and keeps in step with inflation. The artificiality of any fixed year as an arbitrary base has been eliminated.

► **Future Allowance** — The allowance for inflation given by Eq. (7) cannot be determined exactly until the end of the year when C_e becomes known. Yet since an inflation allowance is an expense, it is desirable to know its cost at the beginning of the year so that proper charges can be made for goods and services produced during the year.

This might be done by estimating the cost index for the end of the year—but with no assurance of accuracy. A better way is to use the indexes (terminal values) for the previous year as in Eq. (8).

Such a procedure is not the same as being one year behind in the allowance for inflation. Over the long run the effect will be the same regardless of which equation is used. Equation (8) merely insures correctness of the calculation in the long run while permitting a calculation at the beginning of the year.

► **Which Cost Index?** — Allowance for inflation is calculated from a cost index, sometimes referred to as a price index. The U. S. Government compiles many indexes, and private interests issue a great variety.

Chemical Engineering publishes in each issue the latest Marshall & Stevens equipment cost indexes. Other cost indexes have been discussed in *Engineering News Record*, also a McGraw-Hill publication, for Dec. 6, 1956.

No single cost index will be suitable for all users. Most will find it necessary to divide the assets into groups which follow similar cost changes from the effects of inflation, and then employ different indexes for the different groups.

Excessive grouping is, however, to be avoided. Some groups can be subjected to a weighted index computed from the indexes used for other groups.

Most groups will indicate the nature of the cost index to be chosen. Some groups, like land, will not need one; for others, like cash, there may be no apparent cost index.

The decision can be made from consideration as to why the asset exists. In most manufacturing companies, cash is merely an accessory and is held to a minimum. A cost index for cash might well be an equipment index, a building index, or even a weighted average of the two.

Equations (7) and (8) are in such a form that the cost index used in the calculation can be changed at will at any time without recalculation for the changeover. The index enters in the form of a ratio; only the terminal values need be

How to Figure Allowance for Inflation

The calculation can be made most readily by considering an abbreviated version of the liability side of a balance sheet:

XYZ CHEMICAL COMPANY
Liabilities, Dec. 31, 1958

Current liabilities	
Accounts payable	$200,000
Accrued taxes and other expenses	400,000
Total current liabilities	600,000
Long term liabilities	
Bonds payable	**5,000,000**
Total liabilities	5,600,000
Stockholders' equity	
Capital stock	**5,700,000**
Retained earnings	**1,000,000**
Total stockholders' equity	$6,700,000

Stocks and Bonds

The only significant figures for the purposes of this discussion are those referring to bonds payable, capital stock and retained earnings. As for the first two expenditures, the following information is available:

In 1947, $4 million in capital stock was issued.
In 1947, $1 million of land was purchased at cost (with proceeds of stock sale).
In 1954, $1.7 million in capital stock was issued.
In 1956, $5 million in bonds was issued.

Cost Index

A cost index must be selected. A study of the asset side of the balance sheet indicates that the assets purchased with the proceeds from stock and bond sales can be expected to follow Index *A*, an equipment cost index, and Index *B*, a building cost index. The assets are such that the two indexes can be combined by weighting *A* at 0.6 and *B* at 0.4. The weighted indexes for each year are as follows:

Year	Index A	Index B	Weighted Index 0.6A + 0.4B
1947	120	200	152
1954	140	260	188
1956	160	310	220
1958	170	340	238

(Continued on next page.)

The sentinel that never gets relief... Day after day after day, for over 4 years this Beckman oxygen analyzer has maintained vigil on catalyst regeneration. Located eight stories above The Texas Company refinery at Wilmington, California, it has monitored unreacted oxygen, under demanding conditions, with only minimum routine maintenance. Analysis must be continuous, dependable, accurate. ⌘ This Beckman instrument is the only oxygen analyzer to use a direct paramagnetic measurement exclusively, which brings you these advantages: *Dependability...* under the most rugged conditions. *Simplicity...*with no auxiliary measurements to complicate analysis, no extra components requiring extra maintenance. *Accuracy...*with sensitivity and specificity to meet the most critical process requirements. ⌘ Whatever your application, if you want detailed specifications on an oxygen analyzer that withstands tough environments and gives you continuous, dependable answers, write for Data File P-6-14.

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(Continued from p. 78)

Adding It Up

The various liabilities are now treated for the effect of inflation as if it had been included over the years. The $4-million capital stock issued in 1947 can be regarded as two items: $1 million was used to purchase land for which a correction for inflation need not be considered, while $3 million must be subjected to inflation calculations. The tabulation is:

Item	Year	Amount (A_o)	Index for Year (C_o)	Index for 1958 (C_1)	Inflation Allowance $I_1=A_o(C_1-C_o)/C_o$	Present Dollars (A_o+I_1)
Stock	1947	$3,000,000	152	238	$1,697,368	$4,697,368
Stock as land	1947	1,000,000			None	1,000,000
Stock	1954	1,700,000	188	238	452,128	2,152,128
Bonds	1956	5,000,000	220	238	409,091	5,409,091
Total		$10,700,000			$2,558,587	$13,258,587
			Retained earnings		−1,000,000	
			Insufficient retained earnings		$1,558,587	

Missing Money

The allowance for inflation that should have been made is $2,558,587. But only $1,000,000 was retained as earnings, leaving a deficit amounting to $1,558,587. This is a good example of misleading retained earnings. Instead of having $1,000,000 in retained earnings which might be thought to represent expansion, the corporation is actually behind by about $1,560,000 in keeping up with inflation.

The corporation could conceivably borrow $1,560,000 and translate this into manufacturing facilities. The asset value would then be restored to what it would have been had inflation been allowed for. However, the stockholders' equity is not increased by the transaction as it would have been had the inflation allowance been made.

This example has been given in simplified terms to indicate how the calculation is made. Somewhat more detail will be required in an actual case. The bonds issued in 1956 may have replaced, in whole or in part, notes and bonds of earlier years. The situation could then be treated as for the stock which was issued at more than one time.

known for the period under study.

► **Which Assets?**—Since the allowance for inflation is based on asset values, we must decide which assets to include. The criterion is simple: If the asset is such that extra dollars will be required merely for it to hold its own because of inflation, then the asset should be included in the calculation.

Cash will generally be included. In a manufacturing company cash is just as essential as buildings and equipment in conducting business. Cash requirements will increase with the progress of inflation. A bank's cash assets, however, are owed to depositors on a dollar-for-dollar basis and are unimpaired by inflation.

Accounts receivable, prepaid expenses and notes receivable will generally be included. They increase in dollar amount step by step with inflation; the increased dollars will have to be provided for by an allowance for inflation.

Inventory should generally be included. Although items in inventory will increase in value with inflation—and add to income to help offset the cost of inflation—an allowance is necessary to maintain the inventory.

Securities, such as stock in other companies, should increase with inflation and need not be included.

Bonds can be regarded as cash and generally should be included.

Land and permanent improvements of land are not as a rule included. Most land is a non-depreciable asset which will keep step with inflation. If land is subject to depletion then the depleted portion should be included.

Fixed assets, like buildings and equipment, are included. All depreciation should be subtracted as the depreciation charges appear as cash or other assets.

Salvage or scrap value is generally too small to be considered in the calculation of allowance for inflation.

► **Not So Obvious** — Goodwill, patents and trademarks are carried at a very small value in a large company and can be excluded from the inflation allowance calculation. But in smaller companies and in partnerships, goodwill, etc., may have been purchased at considerable cost and should be included in the calculation to insure recovery at full value, although in depreciated dollars.

Franchises, if perpetual, generally will not be included since they can be expected to increase in value with inflation. If granted for a limited time, the franchise should be included.

Whatever the asset, be sure to make the allowance for inflation after deductions for depreciation, amortization, depletion and similar charges.

In a manufacturing company, consider assets apart from the means by which money was raised to create the assets. It does not matter that a company has a large outstanding bond issue payable on a dollar-for-dollar basis. The assets created by those dollars belong in another category—they must be replaced some day, remember—and should be considered in the calculation.

FREDERIC C. JELEN is among CE's most prolific authors. Since 1956 he has written eight articles for us, all in an engineering economics vein. A graduate of M.I.T. and Harvard, Dr. Jelen is a corrosion engineer with Solvay Process Div., Allied Chemical Corp., Syracuse, N. Y. He is a licensed professional engineer in New York State.

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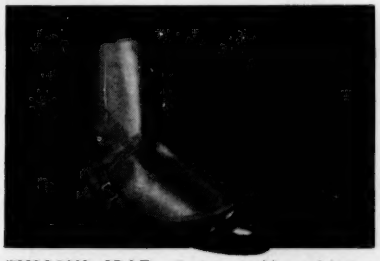

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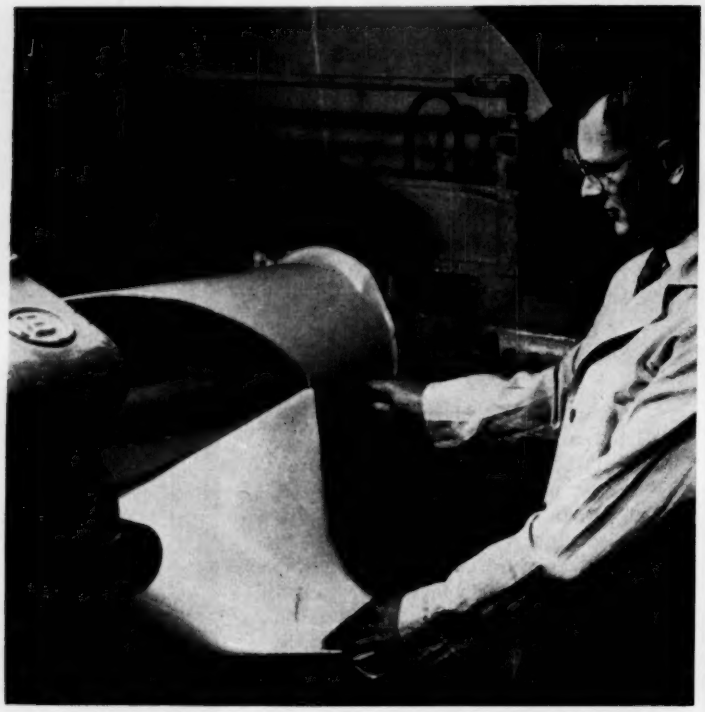


BOON TO FABRICATORS, firmness, density replace soft stickiness of silicone rubber.

Silicones Come Unstuck

In one swoop, Dow Corning has introduced a line of seven silicone rubbers, all out of character for silicones just enough to make fabrication easier. Company has found additives which give the new stocks firmness and density without sacrifice to properties.

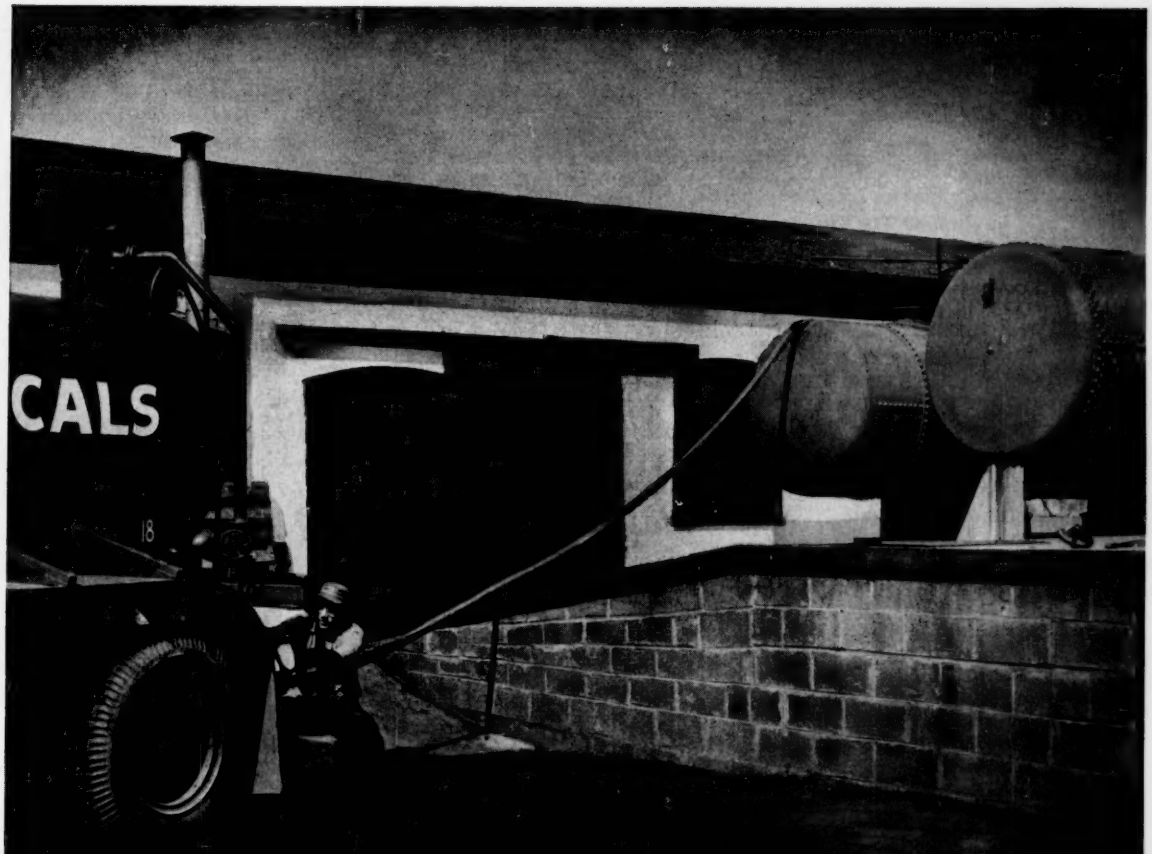
Fabricators will no longer have to amend conventional rubber fabricating techniques to cope with softness and stickiness of silicone stocks. For example, as the upper photograph shows, scraper blades—formerly necessary to get silicone stock off a mill—are no longer necessary. The lower photograph shows one of the new stocks with yet another refinement to meet specific need of the fabricator of wire and cable insulation. Called Silastic 1601, the material requires no mill freshening prior to extrusion. Packaging is in "hats" or strips ready for direct feeding from the shipping container into the extruder. It is a low cost product designed to meet Underwriters' Laboratories standards SF and SFF for flexible cord and fixture wire.

For use in insulating aircraft wire, nuclear shipboard cable, ignition wire and industrial power and control cable, Silastic 1602 is said to offer a combination of good physical and electrical properties and excellent heat resistance. Available with or without vulcanizer it is easily milled, colorable.

Another member of the new line is an easy-to-process cousin to LS-53, Dow Corning's fuel, solvent and oil resistant fluorosilicone rubber (*Chem. Eng.*, July 13, 1959, p. 67). Called LS-63U, the new compound is expected to find use in the missile and aircraft industry where flexible seals and gaskets are required to withstand fuels and oils that swell and deteriorate most other elastomers.

Availability of the first fuel and solvent resistant silicone rubber masterbatch has also been announced. Identified as Silastic LS-422 Base, it permits rubber companies to design fluorosilicone compounds with physical and solvent resistant properties appropriate to a specific application. Composed of a fluorosilicone polymer with a quantity of reinforcing silica filler, it accepts additional fillers so that compounds up to 80 durometer can be formulated.

Two new general purpose compounds, Silastic 52 and 82, are designed for many types of applications, including gaskets, seals, diaphragms and tubing for



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aircraft, automotive and appliance industries.

A new silicone rubber masterbatch for formulating a wide variety of finished compounds has also been introduced. Identified as Silastic 433 Base, it is a silicone polymer with reinforcing silica. — **Dow Corning Corp., Midland, Mich.** 82A

Urethane Foam

Can cover, insulate and waterproof foxholes.

Another market — and we can't help hoping this one will stay potential—has been lined up for rigid urethane foam: foxhole linings and covers.

Tested by Dayton Rubber at an Army Test Center in Arizona, foam was sprayed in a 1-in. thick layer on the sides and bottom of shoulder-deep foxholes. Layer hardened to a waterproof coating that provided excellent insulation.

For the cover several strips of preformed flexible polyurethane foam and ordinary wrapping paper were fashioned into a dome shape complete with vision slit. This flimsy form was coated with several layers of rigid polyurethane foam. The resulting cover was strong enough to support a man.— **Dayton Rubber Co., Dayton, Ohio.** 84A

Lithium Compound

Finds markets in manufacture of polyisoprene, polybutadiene rubbers.

Commercial production of n-butyllithium has begun. The chemical is used in the manufacture of such important new synthetic rubber polymers as polyisoprene and polybutadiene. It also is employed as a pharmaceutical intermediate. Initial output will exceed 1,000 lb./mo.

Manufacturing process is based on the reaction of lithium metal and butyl chloride, modified with significant technical improvements which will enable facilities to be expanded easily to meet increasing demand.— **Lithium Corp. of America, Minneapolis, Minn.** 84B

Silicate Ester

Picked as hydraulic fluid for space flight, functions from −65 to 450 F.

When the manned rocket ship X-15 makes its initial thrust into space, a newly developed hydraulic fluid will help to power steer.

The fluid, known as Oronite High Temperature Hydraulic Fluid 8515, will actuate the control surfaces of the X-15 as it rises at more than 3,600 mi./hr. To be launched from a B-52 bomber over southern California, the space ship is expected to reach an altitude of over 100 mi. Present man-in-space record is slightly over 20 mi.

The fluid is a synthesized silicate ester. While petroleum-based fluids tend to sludge at around 250 F., the chemically-based 8515 fluid will perform at temperatures well over 450 F. and as low as −65 F.

The X-15 was built by North American Aviation in cooperation with the Air Force, Navy and the National Aeronautics and Space Administration. In order for the ship to have necessary control surface response, its hydraulic system was designed to operate at a pressure of several thousand pounds per square inch. Selecting the proper fluid to drive this system involved other considerations besides pressure and temperature.

The fluid, for example, must have a high viscosity index (small change in viscosity over a wide temperature range). It is important that the fluid be sufficiently viscous at elevated temperatures. Otherwise, there is a risk of pump failures due to insufficient lubrication and system leakage. On the other hand, it cannot be too viscous at low temperatures or the system will become sluggish.

Low vapor pressure is another important requirement. If the

Newsworthy Chemicals

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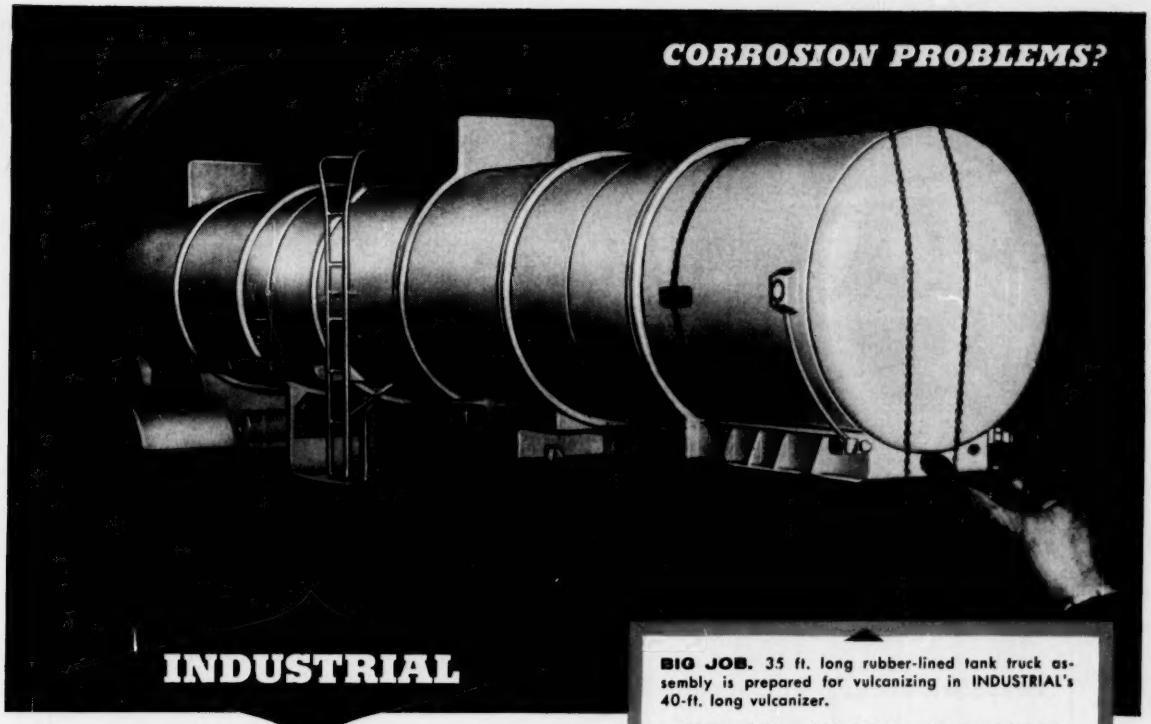
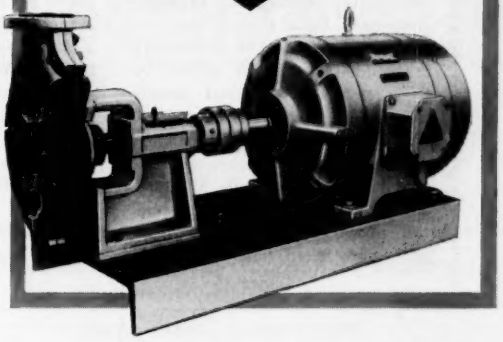


BIG JOB. 35 ft. long rubber-lined tank truck assembly is prepared for vulcanizing in INDUSTRIAL's 40-ft. long vulcanizer.

SMALL JOB. INDUSTRIAL rubber-lined Centrifugal Pumps give long life with minimum maintenance on the most severe corrosion service.



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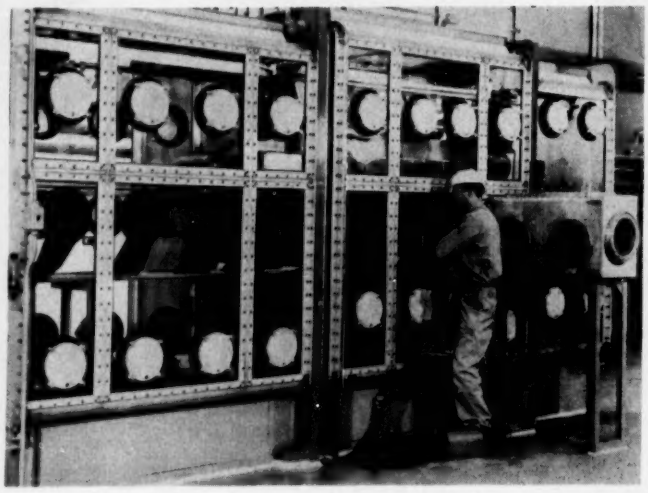

Phenolic Cuts Cost of Handling Pu

In scaling up metallurgical and chemical facilities handling radioactive plutonium, Argonne National Laboratory had to worry about cost of structural materials as well as ability to perform under unusual conditions.

Radioactive materials are handled in sealed interconnected enclosures which provide an inert atmosphere. The enclosures contain portholes into which rubber gloves are fitted, permitting safe access by hand. The problem lay in selecting material for the glove ports which was not only structurally sound, leakproof, and corrosion and fire resistant, but also economical.

Stainless steel and aluminum designs performed satisfactorily but were too expensive. Solution turned out to be compression molded medium impact phenolic molding compound, Durez 1900.—Hooker Chemical, North Tonawanda, N. Y. 86A

vapor pressure is too high, it can create troublesome vapor pockets in the hydraulic system. It may also produce excessive evaporation, which in turn leads to lubricating problems at external locations such as piston rod packings.

The 8515 fluid was especially designed to meet these and other rigid requirements. Its base stock is a special type of silicate ester with superior viscosity-temperature properties. Thickening agents were added to further improve viscosity. Other principal ingredients include oxidation and corrosion inhibitors, and a swelling agent to prevent leakage around gaskets and seals at extreme temperatures.

The new fluid was a joint development of California Research Corp. and the Air Force, and is currently marketed by Oronite Chemical. — **Oronite Chemical, San Francisco. 84C**

BRIEFS

Epoxy plasticizers for vinyl resins, Flexol EP-8 and Flexol EPO, have low volatilities and react synergistically with many metallic stabilizers to increase resistance to heat and light degradation. The former is 2-ethylhexyl epoxy tallate and the latter is an epoxidized soybean oil.—**Union Carbide Chemicals Co., New York. 86B**

Synthetic lubricant called Pentalube TP653 has operated successfully at 425 F. for 100 hr. in engine tests conducted at U.S. Air Force's Wright Air Development Center Laboratories. It is being supplied in substantial quantities to the Air Force for continued development in turbo-jet engines and is available commercially for evaluation in high-temperature applications. — **Heyden Newport Chemical Corp., N. Y. 86C**

Tungsten carbide powder is now being made by a new process by a raw materials producer. Conventionally, it has been produced by tool fabricators using pure tungsten metal powder as raw material.— **Union Carbide Metals Co., Niagara Falls, N. Y. 86D**

Liquid rubber, called Laticrete, is now being used to replace water as a binder in the cement with which glass mosaic tiles are installed. It speeds up cement cure, increases cement's adhesive qualities and makes it waterproof. — **U. S. Rubber Co., N. Y. 86E**

An enzyme product for the hydrolysis and depolymerization of pectin-containing materials in fruit is now being sold. A supplement to natural pectinase, it helps prevent gelling which hinders fruit processing. — **Wallerstein Co., Mariners Harbor, Staten Island, N. Y. 86F**

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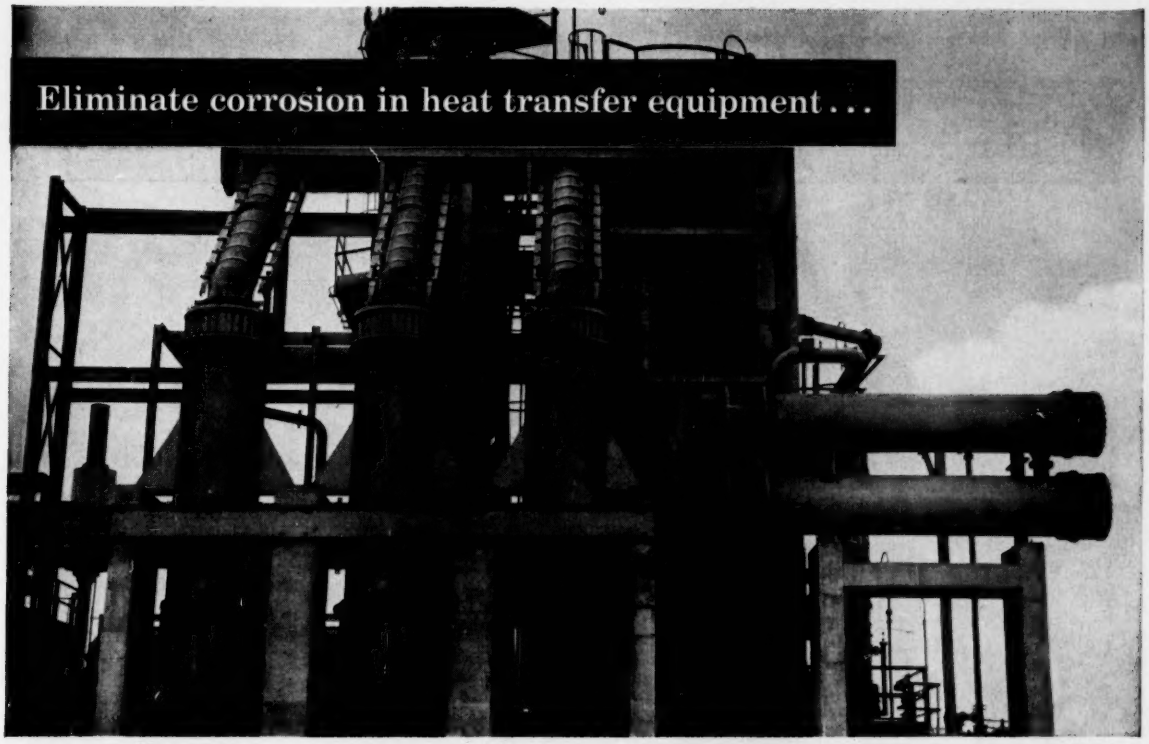
Reader Service

postcard (p. 209)



USE "KARBATE" HEAT EXCHANGERS

Engineered for maximum corrosion resistance and minimum maintenance, these shell and tube heat exchangers are so constructed that all surfaces in contact with corrosive fluids are of "Karbate" impervious graphite. This unique material offers *complete corrosion resistance, high thermal conductivity and immunity to thermal shock.*

Always consider "Karbate" impervious graphite heat exchange equipment where corrosion is a problem. You'll be pleasantly surprised at the low first cost in comparison with heat exchangers having far less effective resistance to corrosion.

Write for Catalog Section S-6800

Buy "Karbate" shell and tube heat exchangers—any size, any type, any design — directly from National Carbon Company, pioneers and experts in heat transfer with corrosives.

Conversions of all sizes of "Karbate" heat exchangers are manufactured in quantity and carried in stock. You save money . . . you save time . . . when you specify "Karbate" impervious graphite shell and tube heat exchangers.

Series	Nom. Size Shell	No. of ⅞" I.D. x 1¼" O.D.	HEAT TRANSFER SURFACE OUTSIDE TUBES, SQ. FT.				
			6' Long Tubes	9' Long Tubes	12' Long Tubes	14' Long Tubes	16' Long Tubes
90	6"	9	17.7	26.5	35.4	—	—
190	8"	19	37.3	55.9	74.5	87.0	99.5
310	10"	31	45.6*	91.2	121.6	141.9	162.2
420	14"	42	81.7	123.3	164.8	192	220
640	16"	64	124.3	187.7	251	293	335
850	18"	85	165.2	250	334	389	444
1090	20"	109	213	320	427	499	570
1350	22"	135	263	397	530	618	706
1630	24"	163	317	479	640	746	852
1950	26"	195	379	573	766	892	1017
2330	28"	233	453	684	914	1065	1217
2680	30"	268	521	786	1051	1225	1400
3490	34"	349	679	1024	1368	1595	1822
4390	38"	439	855	1289	1722	2009	2295
5960	42"	596	1162	1749	2336	2727	3118
6850	45"	685	1335	2010	2685	3135	3585

*This unit has 4½' long tubes.

"National", "Karbate" and "Union Carbide" are registered trade-marks of Union Carbide Corporation

UNION CARBIDE

NATIONAL CARBON COMPANY • **Division of Union Carbide Corporation** • ***30 East 42nd Street, New York 17, N. Y.***

SALES OFFICES: Atlanta, Chicago, Dallas, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco • **IN CANADA:** Union Carbide Canada Limited, Toronto

ONE of many demonstrations at exposition was right-angle stacking.

Cramped Areas No Curb to New Trucks

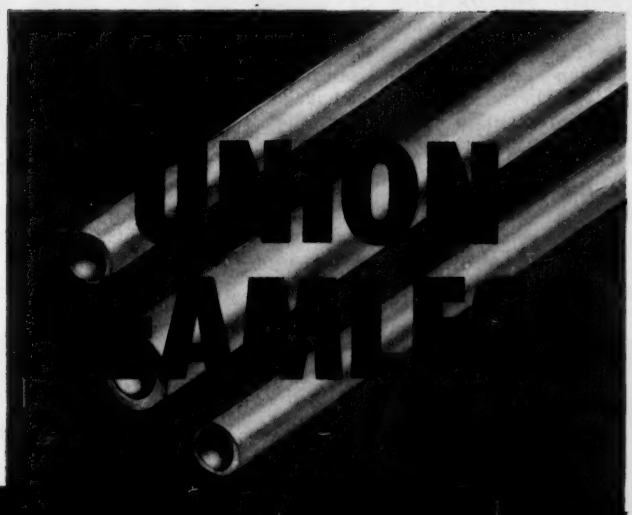
Recent Cleveland exhibit points out growing trend toward aisle-slimming fork-lift trucks of all kinds that boost storage space, cut materials handling costs.

Ability to handle heavy, awkward loads in narrow aisles is undoubtedly a factor of ever-growing importance in modern design of fork-lift trucks. At the recent Material Handling Institute's Exposition (Cleveland), it seemed that just about every truck manufacturer introduced new models aimed at improving three-dimensional maneuverability in confined areas.

Towmotor's contribution (shown above) can stack heavy loads at right angles in aisles only 6 ft. wide. By chopping 4 to 6 ft. off conventional aisle width, the Naro-Aisle-Stacker is said to increase potential storage capacity as much as 50%.

Equipped with hydraulically operated outriggers, the unit can lift loads at 70 ft./min. and maneuver through congested areas with the speed, agility and sit-down comfort of traditional trucks.—**Towmotor Corp., Cleveland, Ohio.** **88A**

Named the NR-40, Clark's reach-type model for narrow aisles is only 38 in. wide. It can stack 4-ft. loads at right angles along a 7-ft.-wide strip. Controls for braking, accelera-



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STAINLESS
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tion and direction selection (forward or reverse) are housed in a single roller-grip handle. Capacity of the six-speed unit is 4,000 lb.—**Clark Equipment Co., Battle Creek, Mich. 88B**

Another reaching model introduced at the show was Lewis-Shepard's ReachMaster. When this truck is positioned before the load, the operator extends the forks into the pallet. Pallet and load are retracted into the truck, raised, extended to the rack and lowered into place.

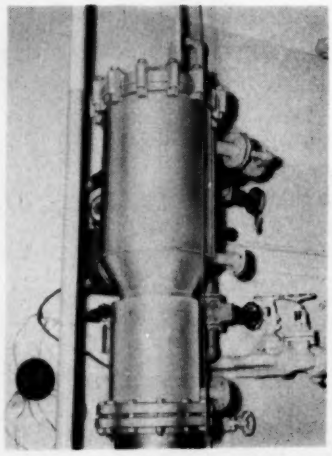
Having a capacity of 2,000 lb., ReachMaster can handle 4-ft. loads in 6-ft. aisles. Lift heights run to 118 in.—**Lewis-Shepard Products, Inc., Watertown, Mass. 90A**

Allis-Chalmers expanded its line to include the 3,000-lb. capacity Model FTB 30-24. Two features upping maneuverability in close quarters are an outside turning radius of only 67 in., and center-point steering, which aids the operator in making tight turns. Power source can be either gasoline or propane.—**Allis-Chalmers Mfg. Co., Milwaukee, Wis. 90B**

A reach-type model, offered in capacities of 2,000, 3,000 and 4,000 lb., was one feature of Yale & Towne's exhibit. Also, Yale showed a side-loading lift truck that can handle pallets as well as long loads in narrow aisles. Company officials claim that side-loading cuts cycling time at the storage position by 50%. Capacity of this unit is 3,000 lb.; maximum stack height is 14 ft.—**Yale & Towne Mfg. Co., Philadelphia, Pa. 90C**

In addition to the heavy-duty Reach-Fork, Raymond Corp. displayed a version of their "4-D" truck (*Chem Eng.*, June 16, 1958, p. 80). This attention-getter can move sideways as well as forward and reverse. Required aisle space is just 7 ft. for loads of any length.—**Raymond Corp., Greene, N. Y. 90D**

Automatic Transportation took the wraps off their new Crab truck, which is similar in concept to the 4-D in that it can move in any direction. Capable of making a complete 360-deg. turn in a 70-in. circle, the Crab is able to reach over one load to lift another behind it. Overall truck width is 43 in.—**Automatic Transportation Co., Chicago, Ill. 90E**



Tower-Top Condensers

Most auxiliary condensing equipment unnecessary.

Direct tower-top mounting of condensers eliminates supporting structures; relatively long, large-diameter vapor lines; reflux pumps and other auxiliaries normally required for conventional condenser installations.

New Series G spiral condensers can be either installed as the top section of a column or directly connected to a vessel's vapor outlet. Essentially, each condenser is an assembly of two long strips of plate wrapped to form concentric spiral passages around a hollow core.

In Series G models, vapor enters at the bottom center. With Type I-G, vapor flows spirally from the center outward to peripheral outlet nozzles. Coolant passes through in the opposite direction.

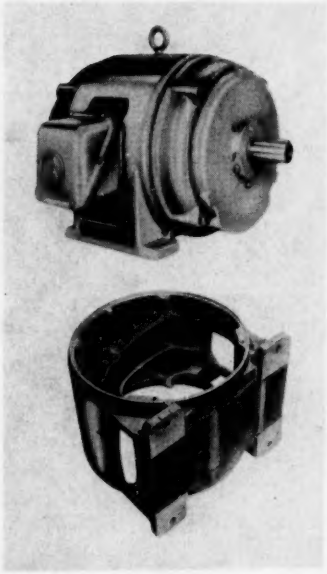
With Type III-G, vapor rises vertically through the core to the vapor dome at top, and then returns downward in crossflow fashion into the open spiral annulus. Sizes range from 15 to 1,600 sq. ft., working pressures to 150 psi.—**The American Heat Reclaiming Corp., New York, N. Y. 90F**

For More Information . . .

about any item in this department, circle its code number on the

Reader Service

postcard (p. 209)



Motor Enclosure

Integral baffles direct circulation pattern.

Dripproof motors of the KVK line feature a completely redesigned and improved enclosure and ventilating system for rerated frames 364 U through 445 U. Heat-dissipating facilities of these motors are claimed to be unusually well distributed—result is a cool motor that provides maximum protection against entering particles.

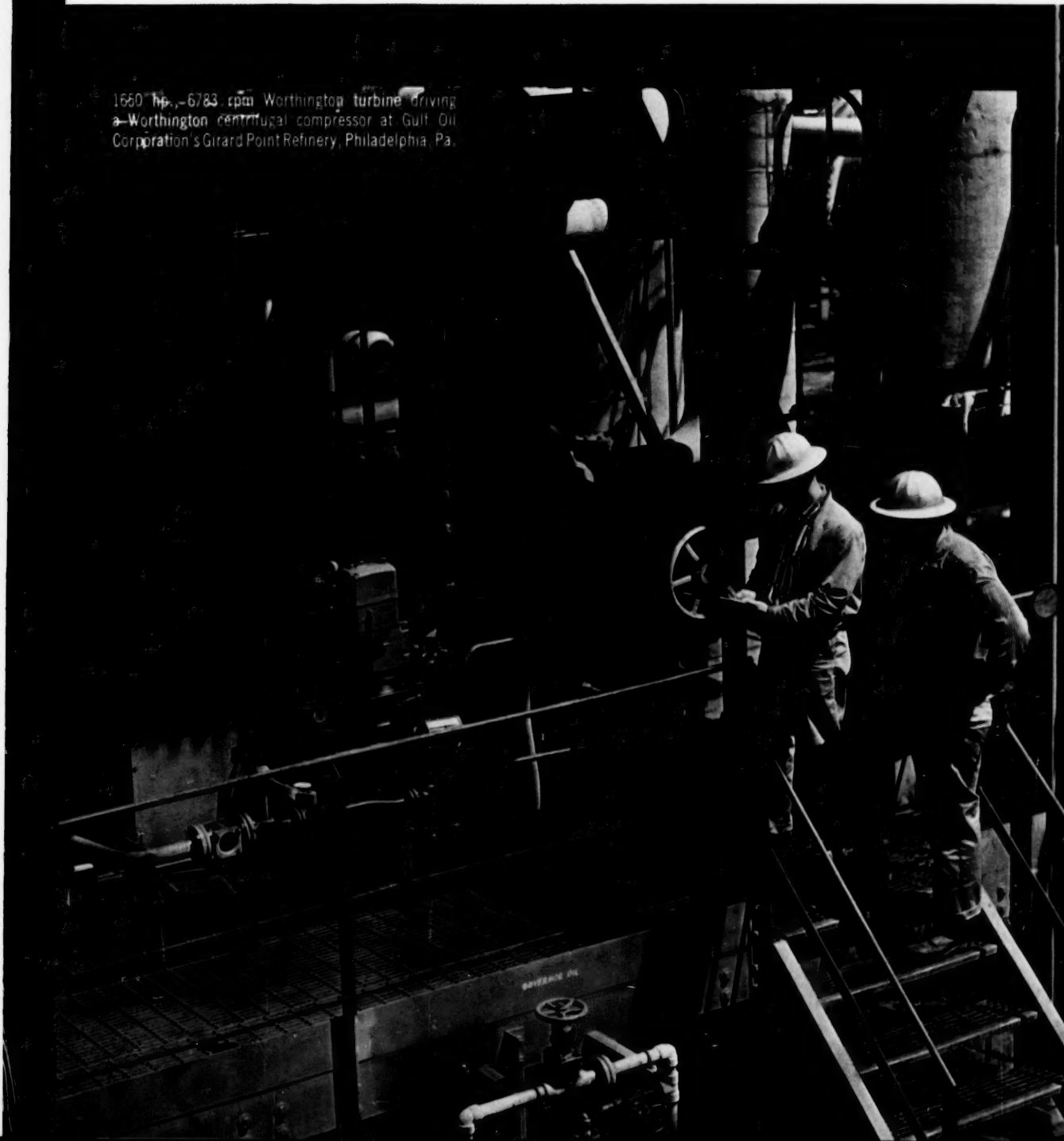
Circulation of ventilating air within the motor's frame is controlled by a series of integral cast baffles illustrated in the photograph. Cooling air moves spirally through the space between the standard core and

1,257,643 HP

OF WORTHINGTON TURBINES NOW DRIVING EVERY MAJOR MAKE OF CENTRIFUGAL COMPRESSOR

More than a million hp of Worthington compressor-drive turbines (and this includes only centrifugal compressor-drive turbines) are now operating around the world. This includes the largest petrochemical unit (we build them up to 50,000 hp), and the fastest (15,000 rpm). There's a "priceless extra" in every Worthington high speed turbine that's behind this remarkable acceptance.

To find out what it is, turn the page ▶



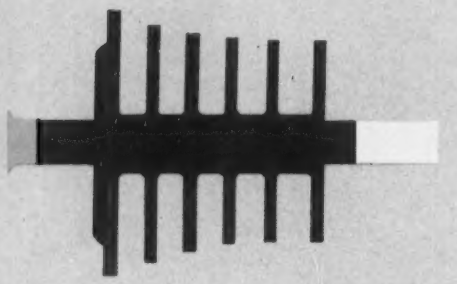
1660 hp., 6783 rpm Worthington turbine driving a Worthington centrifugal compressor at Gulf Oil Corporation's Girard Point Refinery, Philadelphia, Pa.

RELIABILITY

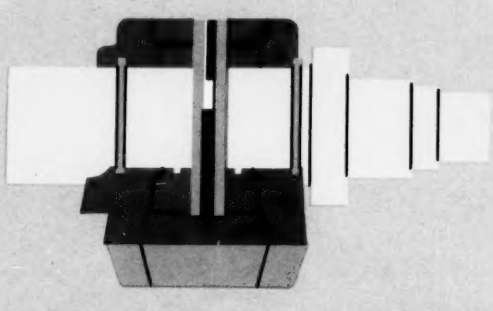
THE PRICELESS EXTRA IN EVERY WORTHINGTON HIGH SPEED TURBINE

Reliability is the ultimate goal of every step that Worthington takes in the design and manufacture of compressor-drive turbines. Reliability is the reason for six extra-quality features shown below. Reliability is the end result of infinite attention to engineering detail based on our 32 years experience in this specialized field. Reliability is the reason Worthington load-tests all multi-stage machines. Reliability is the priceless extra—the single most important reason why more compressor-drive turbines, driving all major makes of compressors, have come from Worthington than any other builder. Worthington Corporation, Wellsville, New York. 48-4

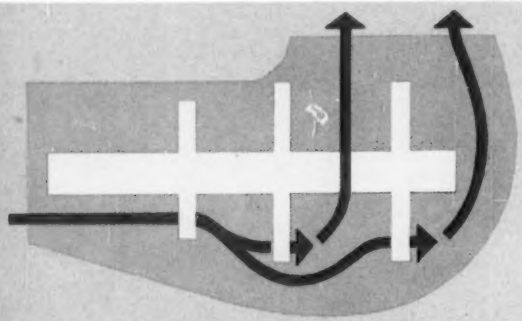
WORTHINGTON



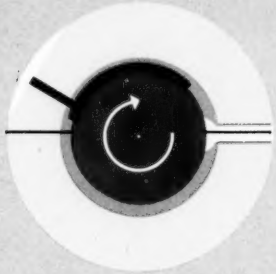
SOLID ROTORS—wheels forged integral with the shaft—provide a more rugged, conservative design.



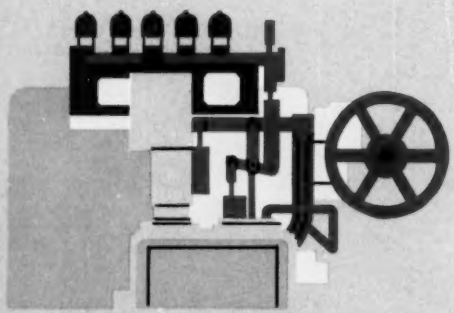
KINGSBURY-TYPE THRUST BEARINGS withstand heavy thrust loads. Shoes pivot, forming a wedge-shaped oil film between thrust collar and bearing surface.



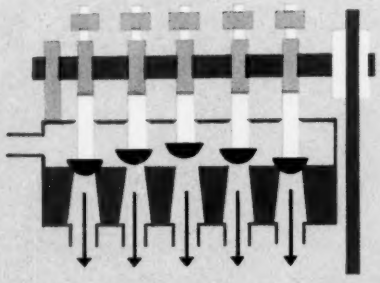
DOUBLE-FLOW EXHAUST—the last stage is divided into two wheels—reduces blade length, increasing efficiency.



ANTI-OIL-WHIP BEARINGS keep vibration to a minimum. An oil dam in upper half of bearing builds up a pressure pad, keeping rotor firmly in place.



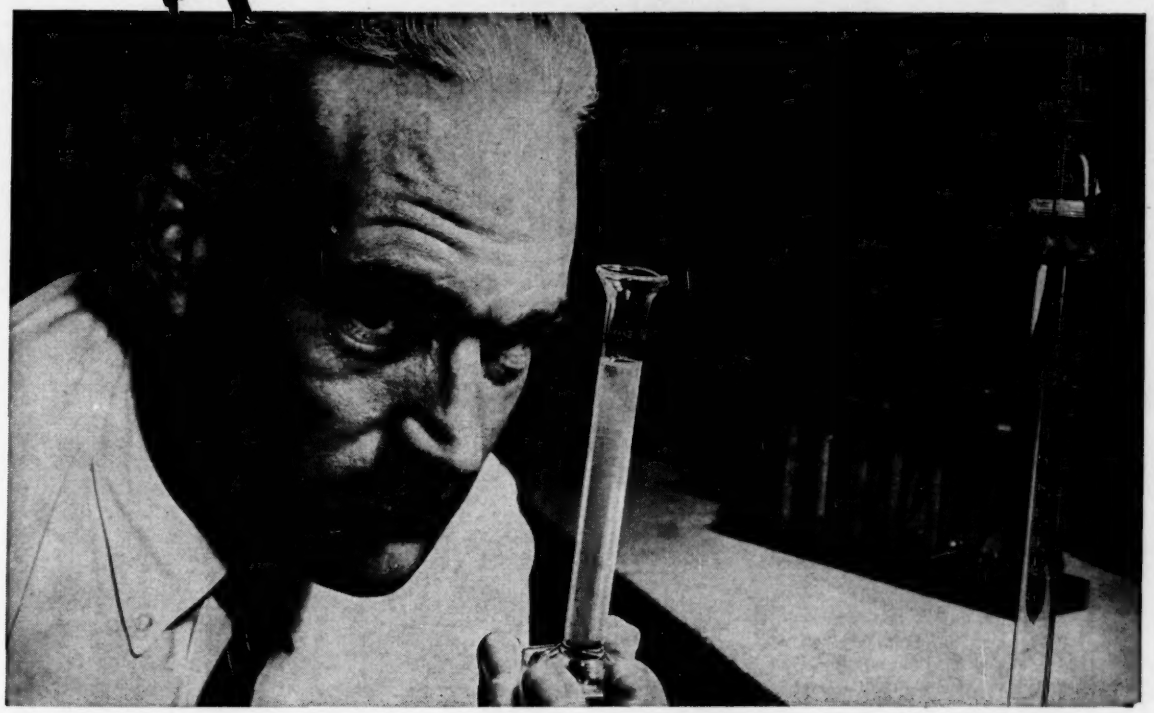
SENSITIVE SPEED GOVERNING SYSTEM provides close control over a wide speed range. (Governor takes air impulses from an outside controller to vary speeds.)



CAM-OPERATED AUTOMATIC NOZZLE CONTROL. Each valve, with separate cam, controls a group of nozzles for maximum economy at all loads.

BRIDGEPORT "T" MEN* IN ACTION

**Technical Service Men*



The Case of the Acid Assailant

Where's the Culprit? **Field spot tests of water samples give revealing clues as to cause of corrosion.**

Case Solved. **Initial recommendations go out to customers immediately and are followed by a detailed written report.**

It was an ordinary afternoon in the Corrosion Lab when a sample of raw cooling water and a corroded condenser tube arrived from a midwest chemical company. Accompanying the evidence was a letter of explanation and a completed Technical Service corrosion questionnaire. The customer wanted help. Bridgeport "T" men swung into action.

The water sample was analyzed. It checked out against the original sample taken when Bridgeport tubes were first installed. Still no conclusive evidence of corrosive media was found in the water. Yet, examination of the tubes revealed them to be corroded both by acid and an abrasive.

The Bridgeport "T" Man visited the plant site and retraced the case step by step.

The first break came when a spot check was made of water taken directly from the cooling tower. A significant acid content was noted. Further on-the-spot examination showed that gas and fly ash from the plant smokestack were carried by prevailing winds over the cooling tower and deposited in large amounts in the tower. Closer examination of the cooling tower uncovered acid-forming sludge and abrasive fly ash in suspension.

The Bridgeport "T" Man, in an extensive report of his findings, recommended corrective measures. Company adopted recommendations. Tubes saved. Case closed.

This is a typical case from the files of Bridgeport Technical Service, a group set up to help Bridgeport customers get maximum life and service from their power and process equipment.

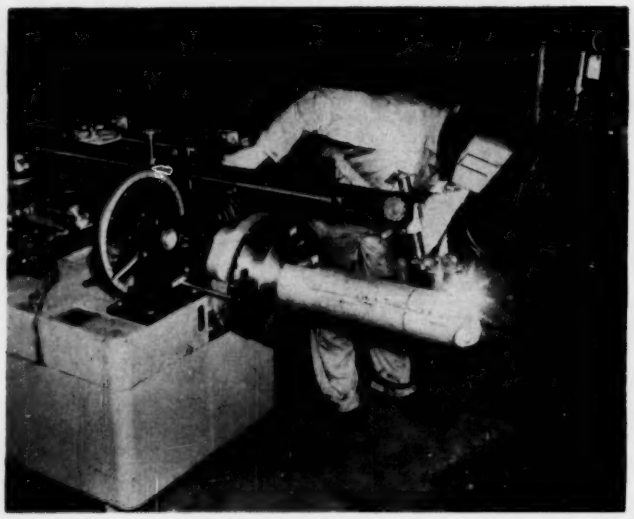
For the best service and advice on condenser or heat exchanger tubes call your nearest Bridgeport Sales Office today.

DEPT. 5009

BRIDGEPORT CONDENSER TUBES

Bridgeport Brass Company, Bridgeport 2, Connecticut

Sales Offices in Principal Cities • In Canada: Noranda Copper and Brass Limited, Montreal



This Pipefitter's Dream Not a Pipe Dream

An automatic pipe-cutter in use at the Hanford atomic plant does everything but say "please" and "thank you" when it makes difficult cuts in stainless steel pipe. The machine's operator merely sets four dials and punches a button—the torch flares and glides through any precise contour and bevel pattern around the pipe in a matter of seconds. Developed by GE, the unit is a combination of Steffan Mfg. Corp.'s Mechanical Draftsman and Linde's Heliarc cutting torch. — General Electric Co., Hanford Atomic Products, Richland, Wash. 94A

motor frame. This assures equal cooling for all portions of the core and winding, regardless of rotation direction. Air intakes are on the end bells, and air exhausts are between the motor feet.—**Fairbanks Morse & Co., Chicago, Ill. 90G**

End-Point Recorder

On-stream device satisfies ASTM D-86.

Engineered by Shell Development Co. and now marketed by Hallikainen, a new on-stream boiling-point recorder gives 97% end-point readout with accuracy that meets requirements of the ASTM D-86 test. Samples tested successfully include gasoline, paint thinner, kerosene and light gas oil.

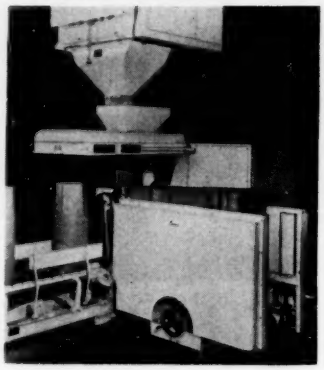
Useful range of the instrument falls between 200 and 600 F. Explosion-proof construction meets all requirements of Class I, Group D installations.

In operation, a constant sample flow (30 ml./min.) runs onto a falling-film flash evaporator where 97% evaporates. Residue (1 ml./min.) drops off the tip of the evaporator, where its temperature is measured by means of a thermocouple. This condition is maintained by heat control to the evaporator via an electronic regulator. — **Hallikainen Instruments, Berkeley, Calif. 94B**

Plastic Drums

Low in cost, units can replace steel drums.

Made entirely of white polyethylene, new injection-molded drums with a 55-gal. capacity are offered at 25% the cost of stainless steel drums. Drum height is 31 in.; inside diameter is 24 in. The drums are equipped with tight-fitting, splashproof lids that fasten securely by means of a steel closure ring. Weight is only 10¼ lb., compared to 65 lb. for steel drums.—**Redmanson Corp., York, Pa. 94C**



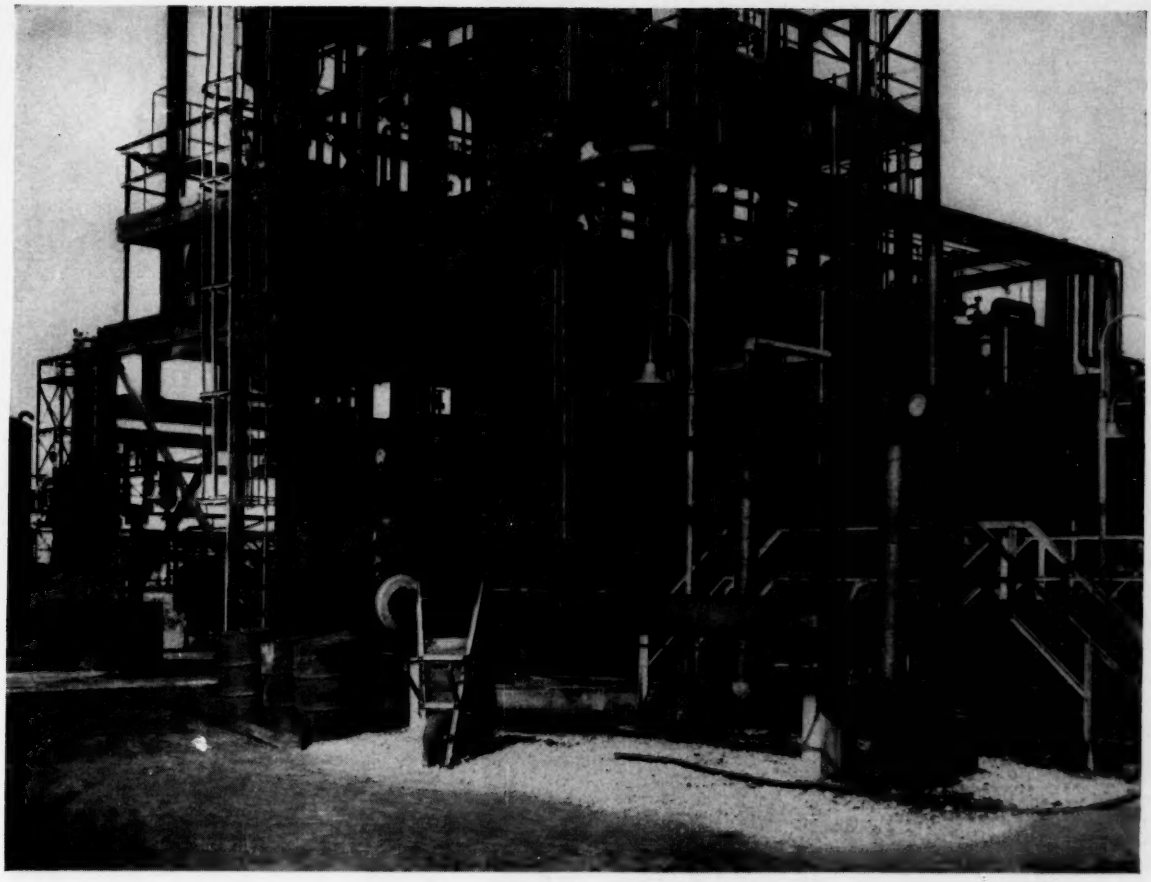
Bag Feeder

Fills multiwall bags at high rates. Good control.

Bemis Bro. Bag Co. has just announced development of the first, fully operational, automatic, open-mouth multiwall bag feeder. The machine normally operates at speeds of 16 bags/min., and at even higher speeds with some free-flowing products.

Each Auto-Mac feeder comes furnished with a new control system for simplicity of operation. A switch activiates the cycling operation; individual controls regulate speed. One handwheel, located on the side

EQUIPMENT NEWS
Continues on . . . Page 178



These three reactor tanks at Celanese Corporation of America, Point Pleasant, W. Va., are of Lukens Nickel-Clad Steel. They stand up well to corrosive chlorides.

Corrosive chlorides don't "put the bite" on these reactors

...*Reactors are made of Nickel-clad steel*

In making tricresyl phosphate for automotive and other uses, Celanese Corporation of America has its share of corrosion problems.

Although the final product is non-corrosive, the acidic raw materials and by-products could cause plenty of trouble for processing equipment if it were not adequately protected. The reactors, for example, are exposed to cresylic acid and phosphorus oxychloride. Storage tanks must handle hot crude tricresyl phosphate containing small amounts of hydrochloric acid.

In both places, Lukens Nickel-Clad Steel equipment is used not only to resist general corrosion, but also to prevent stress-corrosion cracking. Nickel and Monel* nickel-copper alloy are used at other points in Celanese's Point Pleasant, West Virginia plant where corrosion resistance is of prime importance.

Do you have a corrosion problem involving acid chlorides? Why not write for a copy of our Technical Bulletin T-29? It may suggest an answer.

*Registered trademark

The International Nickel Company, Inc.
67 Wall Street New York 5, N.Y.

INCO TRADE MARK

Inorganic Acid Chlorides in which satisfactory use of Monel or Nickel is recorded

Corrosive Media	Monel	Nickel
Aluminum Chloride ...	Yes	–
Ammonium Chloride ..	Yes	Yes
Antimony Chloride ...	Yes	–
Arsenic Trichloride ...	Yes	Yes
Magnesium Chloride ..	Yes	Yes
Manganous Chloride ..	Yes	–
Nitrosyl Chloride	Yes	Yes
Phosphorus Oxychloride	–	Yes
Phosphorus Trichloride	–	Yes
Silicon Tetrachloride .	–	Yes
Sulfur Monochloride ..	Yes	Yes
Sulfuryl Chloride	Yes	Yes
Tin Tetrachloride	Yes	–
Zinc Chloride	Yes	Yes

INCO NICKEL ALLOYS

BEHIND THIS VALVE...

four ways you save with CARBIDE'S ethanolamines

No idle claims!—just four facts that show how you save with CARBIDE's ethanolamines:

HIGHEST QUALITY . . . means trouble free use—less down time and waste. Quality is assured because CARBIDE's ethanolamines are triple-tested—after production—during storage—and on shipment.

DELIVERY ON TIME . . . fills your inventory needs and meets your production schedules. With 50 warehouses, 18 bulk stations, and 2 producing sites—plus a rapid communications network—CARBIDE is your most reliable source for ethanolamines.

COMBINATION SHIPMENTS . . . bring you big dollar savings on mixed shipments with other CARBIDE chemicals in compartment tank cars, tank trucks, and drums in truckload quantities.

TECHNICAL SERVICE . . . helps save your time in application research and production. CARBIDE has the most ethanolamines experience—34 years—and a technical laboratory staff of experts ready to help you.

A new booklet on CARBIDE's Alkanolamines and Derivatives is now available. Application information is combined with physical properties specifications, and shipping data, to give you the ethanolamines story at a glance. Ask your CARBIDE Technical Representative for a copy, or write: Union Carbide Chemicals Company, Room 328, Department HE, 30 East 42nd Street, New York 17, New York.

UNION CARBIDE CHEMICALS COMPANY

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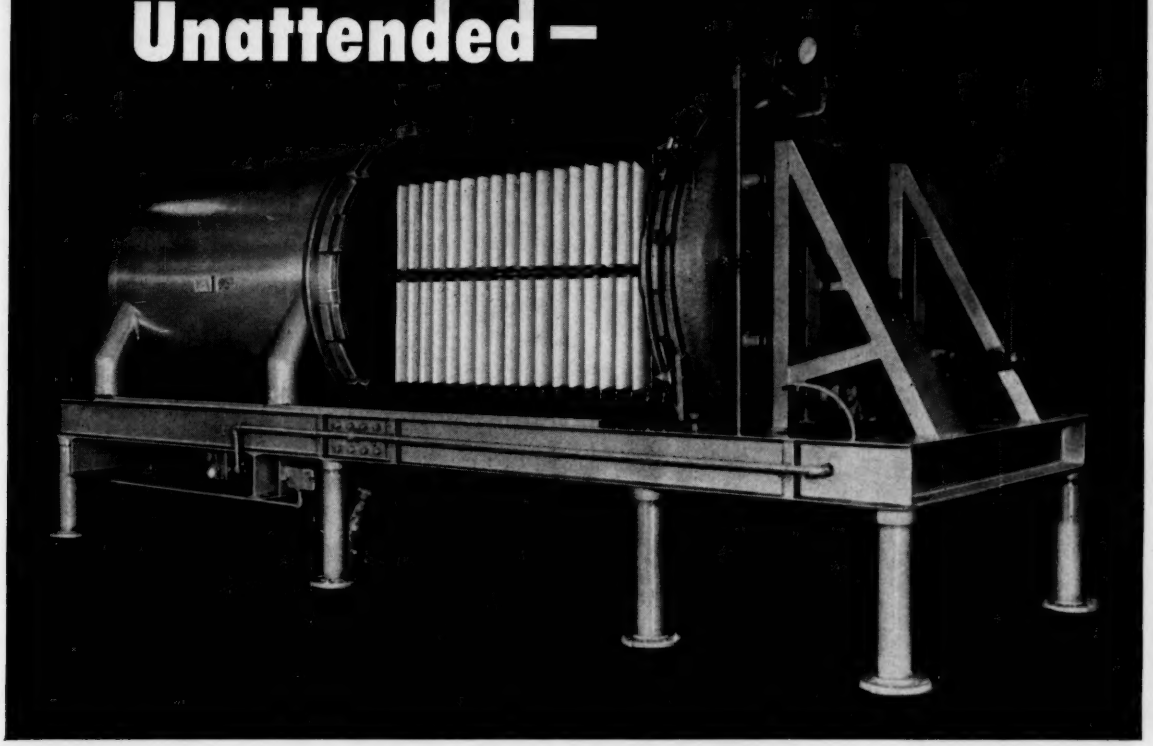
Now Available
Completely Automated for Continuous Operation Unattended—



SPARKLER Model MCR-S FILTER

This heavy duty, large volume filter, will give fine filtration as well as handle products with a high percentage of bulky solids. Model MCR-S filters now in service, equipped with completely automatic operating controls are performing day after day without attention. Precoating, filtering, blow-down to a dry cake, cake discharge and resuming the filtering cycle, all automatic. Write for details of this new self operating filter. Capacities up to 1000 sq. ft. of filtering surface.

Consult Sparkler for the latest proven developments in filtration. Originators of the Horizontal Plate Filter and Fully Automatic Horizontal Leaf Filters.

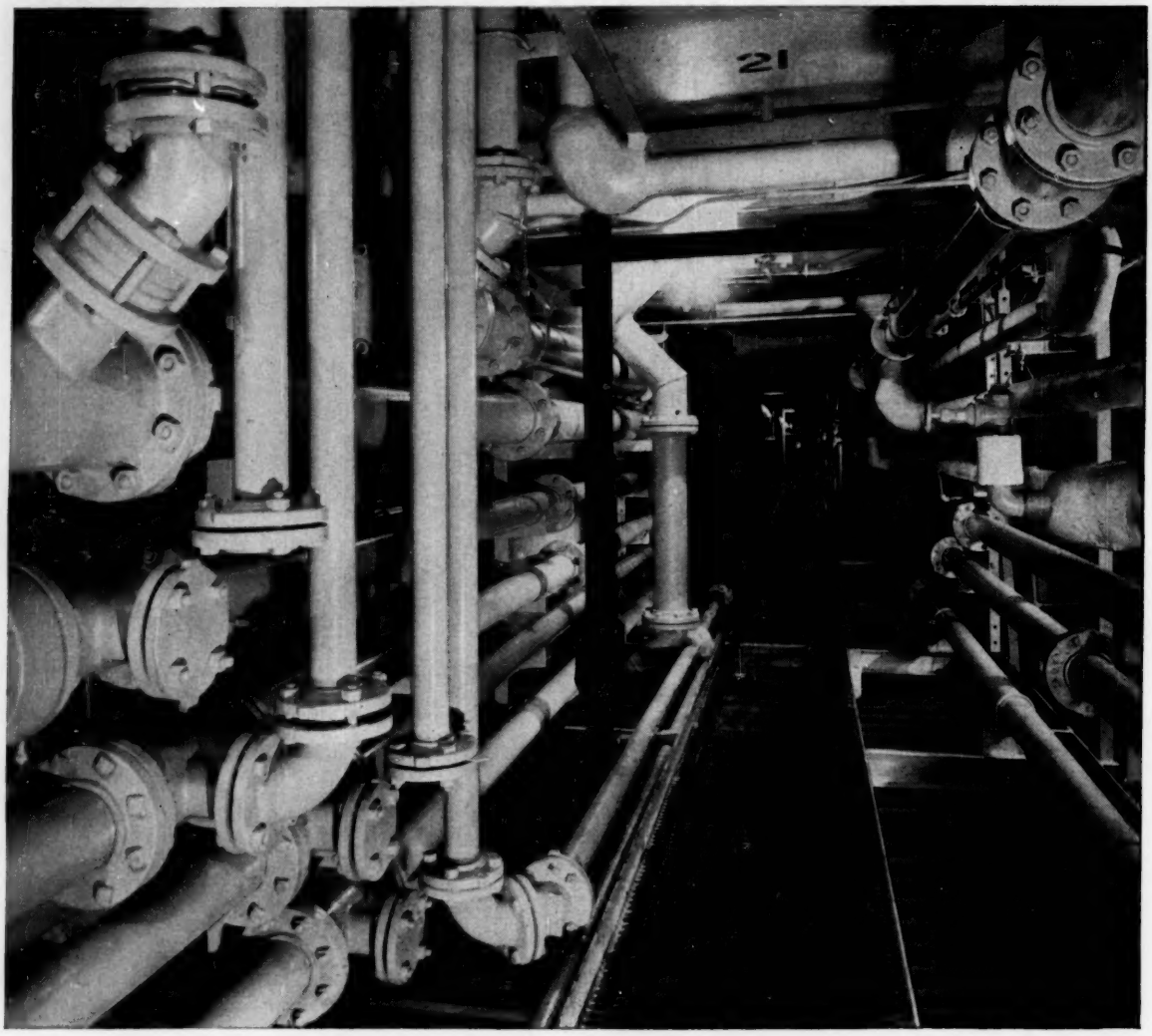
SPARKLER FILTERS

SPARKLER MANUFACTURING CO.
MUNDELEIN, ILLINOIS, U. S. A.

Sparkler International Ltd., Manufacturing Plants at Leliegracht 9, Amsterdam, Holland; Toronto, Ontario, Canada; Italy and Australia.

FILTRATION ENGINEERS AND MANUFACTURING EXCLUSIVELY FOR OVER 35 YEARS

DOW | **SARAN LINED PIPE**



After six years of hot sulphuric acid . . .

Saran Lined Pipe still performs dependably

When 20,000 linear feet of pipe must carry a constant stream of hot sulphuric acid . . . when production requirements make pipeline failure intolerable . . . pipeline dependability is the lifeline of the plant. For the past six years, Saran Lined Pipe has carried dependably an unending flow of corrosive chemicals at Industrial Rayon Corporation's Painesville, Ohio, plant.

The installation shown above carries hot sulphuric acid and other chemicals used in Industrial Rayon's Continuous Process method of making tire cord. This Saran lined supply and return piping, serving all of the plant's spinning machines, carries the solutions from lower levels to spinning machines on the main floor. Pumping pressures range from 45 psi upward, and solution temperatures are above 125° F.

The Saran Lined Pipe was installed in 1953 and has been in continuous use since. Maintenance costs have been extremely low and I.R.C. engineers report that, during these six years, Saran Lined Pipe has performed dependably under their corrosive operating conditions.

Whenever dependable piping systems are required, whatever the degree of corrosion or chemical activity, consider Saran Lined Pipe. Saran Lined Pipe, fittings, valves and pumps are available for systems operating from vacuum to 300 psi, from below zero to 200° F. They can easily be cut, fitted and modified in the field without special equipment. For more information, write Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale, Michigan, Dept. 2282AK8-10.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

Why Hunter Packing Company uses STANOIL Industrial Oil

Two reasons: (1) STANOIL is a superior oil. (2) Along with STANOIL, Hunter Packing receives experienced lubrication technical service.

A special antioxidant in STANOIL gives the oil resistance to *chemical* change. Deposits are minimized. The oil has a high viscosity index, is resistant to *temperature* change. It lubricates effectively at both high and low temperatures. Due to special refining techniques, STANOIL will not readily emulsify. A special additive minimizes foaming. STANOIL has a low pour point. It flows freely at low temperatures. A rust inhibitor in STANOIL "plates out" on metal surfaces.

W. P. "Sandy" Wehking, the Standard Oil man who calls on Hunter Packing Company, has plenty of experience in technical service work. He's been at it for 17 years. Sandy studied chemistry at Blackburn College. He has also completed the Standard Oil Sales Engineering School.

To get more information about STANOIL Industrial Oil and to obtain technical help on your lubrication problems, call the Standard Oil office near you in any of the 15 Midwest or Rocky Mountain states. Or write, **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

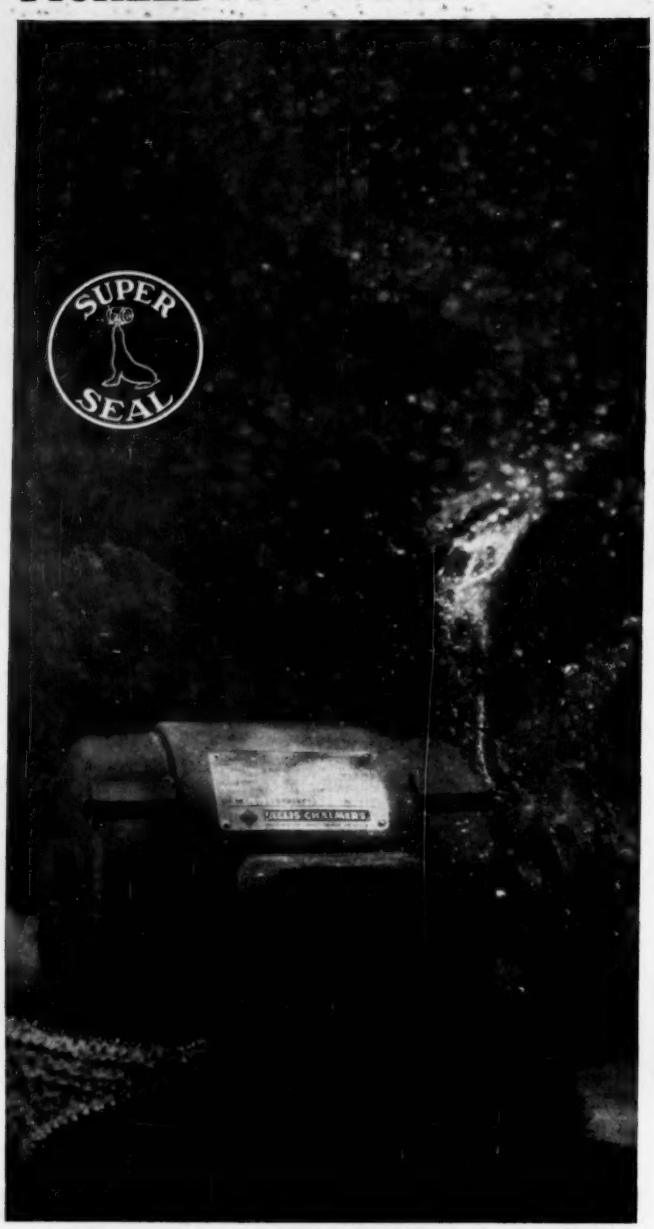
Quick facts about
STANOIL Industrial Oil

- Antioxidant gives oil resistance to chemical change, minimizes deposits.
- Inhibitor "plates out" on metal surfaces, prevents corrosion.
- Receives special refining to eliminate emulsion problems. Contains additive to minimize foaming.
- High viscosity index. Resists temperature change.

You expect more from STANDARD *and you get it!*

Temperature check. Frank Persson of Hunter Packing Company and Standard Oil lubrication specialist W. P. "Sandy" Wehking inspect one of four compressors in Hunter plant that uses STANOIL Industrial Oil.

PICKLED in a 4% brine solution!



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in a tornado of abrasive dust!

FROZEN
for weeks at 75° C below zero!

BURIED ALIVE
in thick, sluggish mud!

nothing . . . but nothing stops Super-Seal open-type motors

Thanks to exclusive Poxeal and Silco-Flex insulations, Super-Seal motors have shown endurances that even enclosed motors couldn't match. Results and reasons available from your A-C representative or distributor. Or write General Products Division, Milwaukee 1, Wisconsin

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ONE OF A SERIES

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Certainly *not* as a part of your research department.

Nor as a member of your new-product-development team.

But as a pipeline for helpful data and technical assistance to both . . . and as an invaluable aid to your manufacturing departments, particularly in quality control.

For, Wyandotte technical service has a reputation for being able to furnish the kind of helpful technical assistance scientists want.

For accurately preparing extensive and comprehensive data on the chemical and physical properties, along with other pertinent characteristics of all Wyandotte products . . . their specifications and limitations.

For being helpful to users in the application, handling and storage of our products.

And equally important to you: because technical service is deep-rooted and sincere at Wyandotte, technical assistance is readily available to you at raw material procurement, research, development, manufacturing, sales, and shipping levels. This also includes, of course, consultations with Wyandotte science-specialists* on specific areas of product application.

Your request for assistance, accompanied by as much background data as possible, will put our facilities to work on your problem.

For a pictorial presentation of Wyandotte technical service at work, please turn page.

*Chemists, Chemical Engineers, Physicists, etc., whose industrial or research experience qualifies them as specialists in their particular field.

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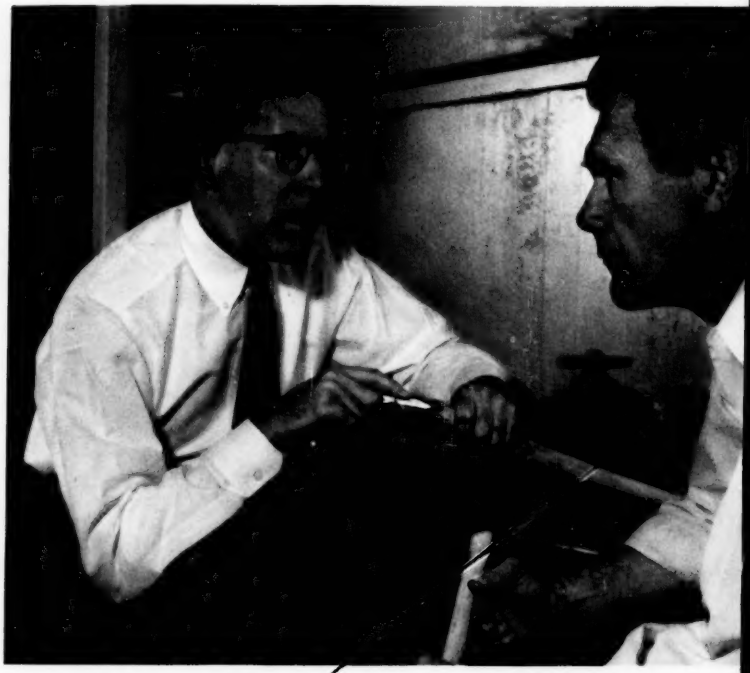
Protecting the quality of liquid bleaches

. . . an example of Wyandotte technical service at work

1 A customer phones Wyandotte to report trouble with instability of his bleach. The technical-service man asks him to send samples of all the raw materials and finished products involved. These will be carefully tested in Wyandotte's laboratories.

QUALITY MUST first be achieved . . . then protected and maintained. Wyandotte technical service can often be of assistance in both areas. And it's available to all Wyandotte customers. If you have a problem that falls within our technological or manufacturing background, check with us . . . our approach is designed to provide answers. *Wyandotte Chemicals Corporation, Michigan Alkali Division, Wyandotte, Mich. Offices in principal cities.*



2 The laboratory tests indicate that a trace of impurity is at fault, so the technical-service man inspects conditions at the customer's plant. A thorough search revealed that this worn-out piece of equipment was causing the contamination.

Wyandotte CHEMICALS

Pacing progress with creative chemistry

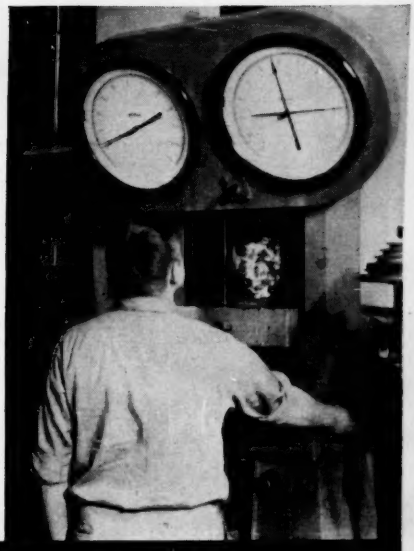
3 A complete report is prepared and submitted to the customer. It covers the nature and cause of the contamination, and how to correct the process to prevent recurrence. A new piece of equipment was recommended, using new materials of construction.

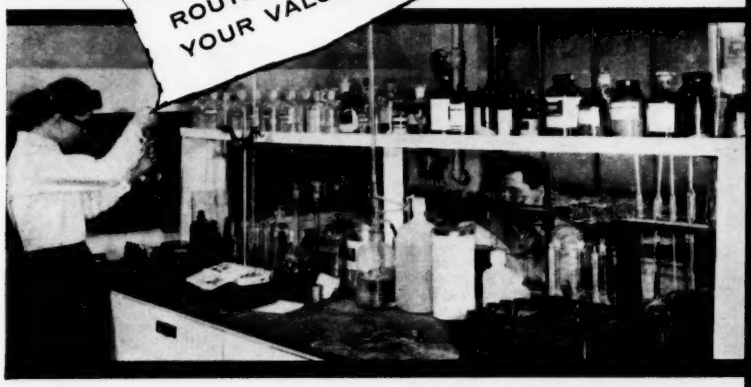
4 Wyandotte's recommendations are accepted. Several weeks later, the technical-service man and Wyandotte sales representative discuss progress with the customer over lunch. The customer reports a completely stable, contamination-free product.

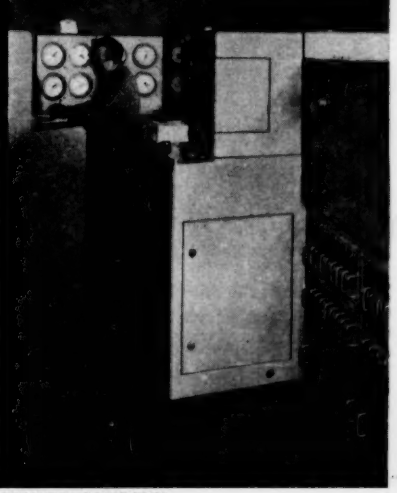
725

WAUKESHA FOUNDRY RESEARCH

MAY WELL PROVIDE THE ANSWERS TO YOUR PROBLEMS IN CORROSION RESISTANT CASTINGS







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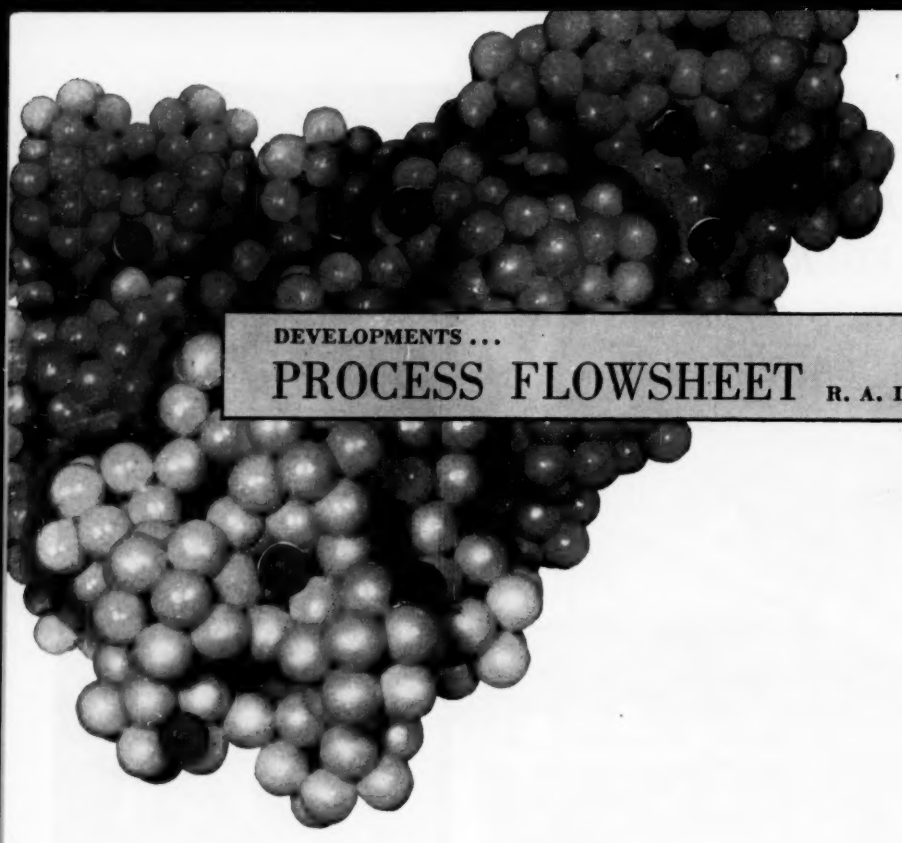


DEVELOPMENTS . . .

PROCESS FLOWSHEET

R. A. LABINE

Molecular Sieve Process Revealed

Here is your first opportunity to get a guided tour through a plant making these versatile synthetic adsorbents.

TONAWANDA, N. Y., might be termed the "birthplace of molecular sieves." There for the past five years, Linde Co., a division of Union Carbide, has been producing these synthetic zeolite adsorbents. Plant capacity is identified only as "tons per day," but indicative of the demand that is developing, Linde says a six-fold plant expansion is under way.

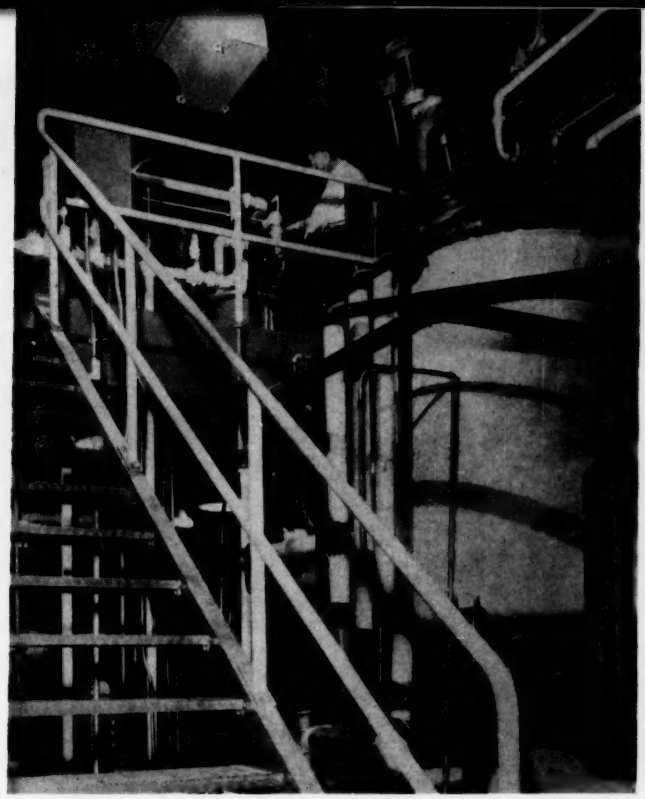
Molecular sieves adsorb materials by inclusion of molecules in the microscopic pores in the sieve crystals, differing from the action of other adsorbents like charcoal and silica gel. Commercial uses for these sieves are mushrooming, latest being the gasoline upgrading processes announced by Texaco and Universal Oil Products. Linde also has developed much basic data on use of molecular sieves for hydrocarbon separation which it is currently distributing to petroleum and engineering companies.

Another indication that molecular sieves are heading into the big time is that another company —Davison Chemical—recently jumped into the field, challenging Linde's position as sole supplier.

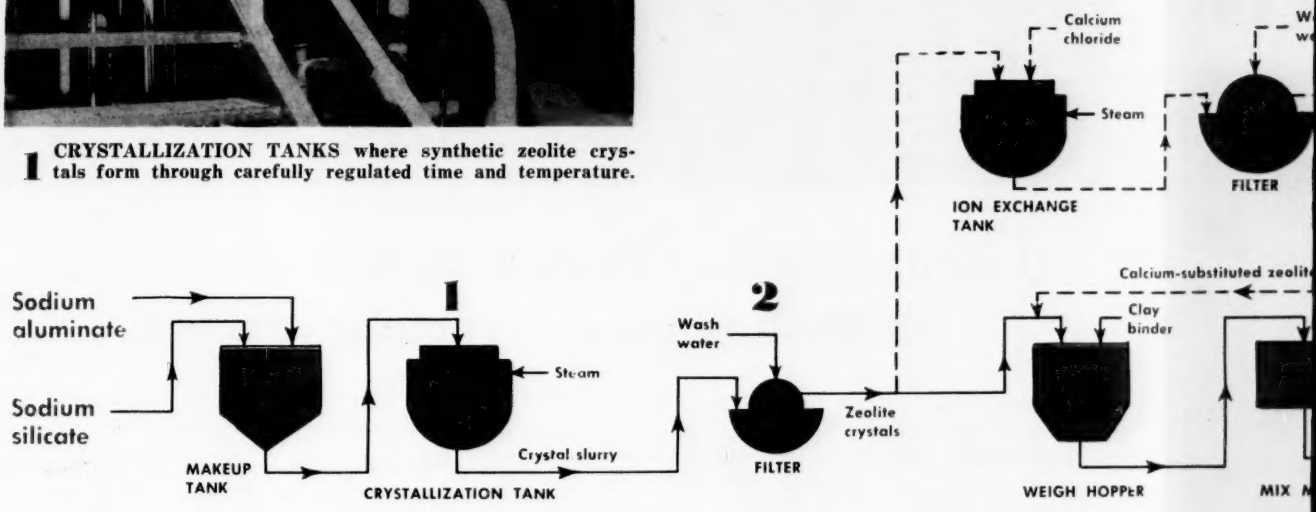
▶ **Why They Work**—Composition and physical structure of molecular sieves are outlined in two composition-of-matter patents recently issued to Linde (U. S. 2,882,243 and 2,882,244).

Briefly, molecular sieves consist of three-dimensional frameworks of SiO_4 and AlO_4 tetrahedra. Electrovalence of each tetrahedron is balanced by the inclusion in the crystal of a metal cation; e.g., Na, Ca, Mg. Spaces between the tetrahedra are

Unfold Flowsheet



1 CRYSTALLIZATION TANKS where synthetic zeolite crystals form through carefully regulated time and temperature.



occupied by water molecules prior to "activation" —kiln firing to drive out the water, leaving the voids which act as molecular traps.

Metal cations in the crystal are located close to the pore openings; by exchanging the sodium ion (in the zeolite after first crystallization) for a smaller or larger ion, Linde can vary pore openings from 2-3 Angstroms to 10-12 A.—tailoring the sieves to particular applications. For example, 4- or 5-A. pore openings are ordinarily used for gas drying and gasoline upgrading while a 10-A. sieve might be used for removing oil vapor from a gas stream or removing hydrogen sulfide from natural gas.

▶**Crystal Forming**—Linde's processing scheme is divided into two sections: Formation of the zeolite crystals, then forming of the molecular sieve pellets.

Sodium silicate, sodium aluminate and sodium hydroxide—in ratios varying with the type of sieve desired—are metered to a mix tank and stirred until homogeneous. Resulting gel is pumped to a crystallization tank where it is maintained at about 212 F. for a period of several hours, depending on crystal structure being produced. Progress of crystallization is monitored by several quality control techniques including x-ray diffraction.

Crystal slurry then filters and washes on a rotary vacuum filter. To make chemical-loaded molecular sieves (*Chem. Eng.*, Apr. 7, 1958, p. 72) filter cake is sent to another section of the plant. If calcium ions are to be substituted for sodium in the zeolite crystal, filter cake is transferred by screw conveyor to a heated tank where it mixes with a calcium chloride solution. Degree of ion exchange can
tact and solut
▶**Pellet Proce**
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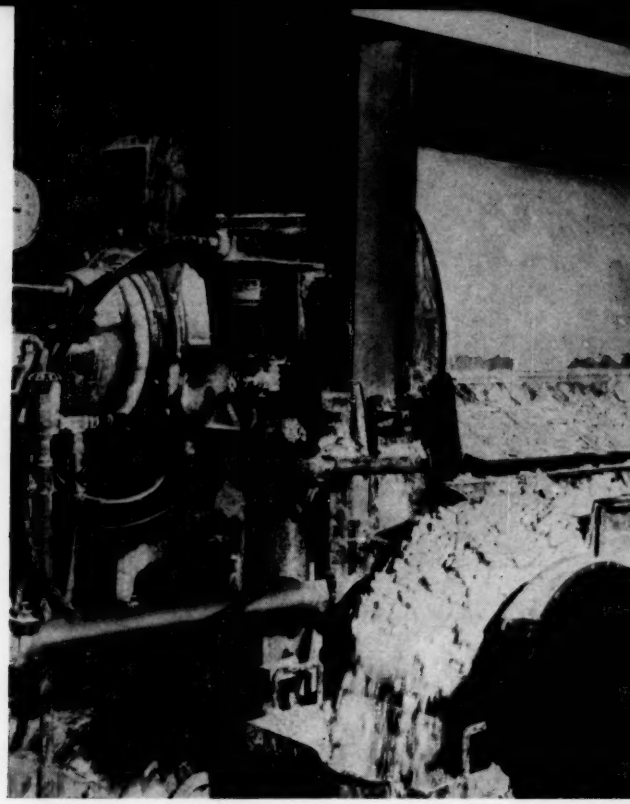
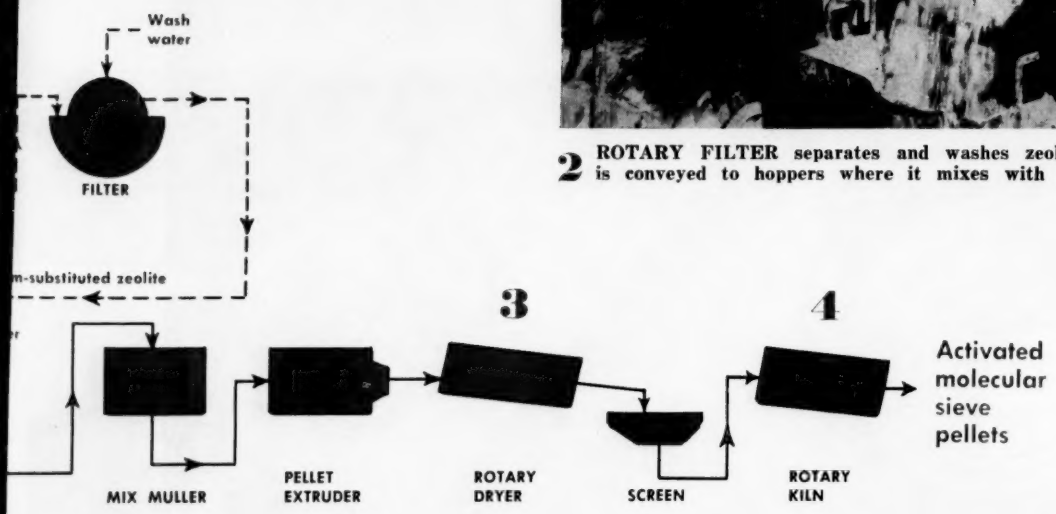


2 ROTARY FILTER separates and washes zeolite crystals is conveyed to hoppers where it mixes with clay and is



exchange can be controlled by varying time of contact and solution temperature.

▶ **Pellet Processing**—To form molecular sieve pellets, zeolite crystals from filter (most in the 0.1 to 10 micron range) are mixed with clay binder and fed to a special extruder. Pellets are then dried, screened and fired in a rotary kiln at about 1,200 F. to drive out the water of hydration and activate the sieves. Pellets are immediately packaged in sealed drums to prevent any moisture pickup.

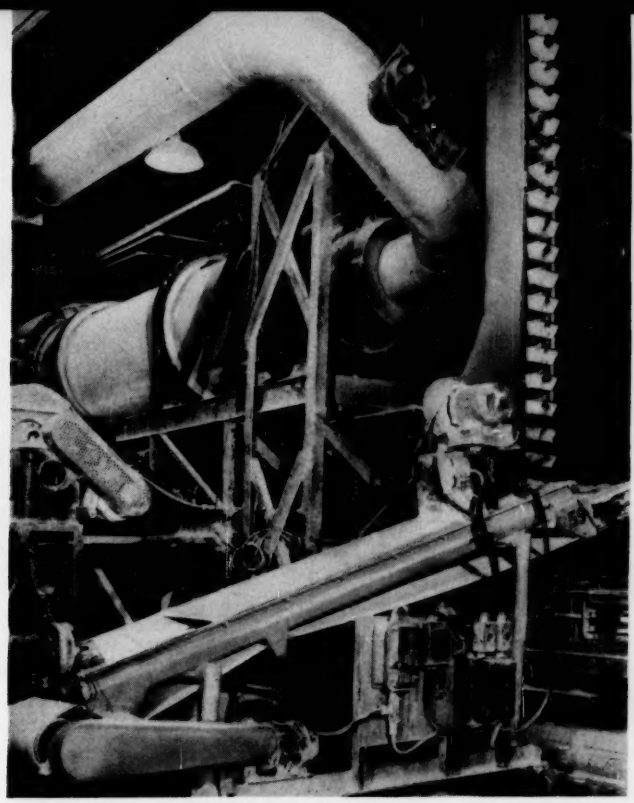
No special corrosion problems were encountered in this plant; mild steel and wrought iron is satisfactory except for pumps and valves where stainless alloys are employed. The most corrosive chemical handled, hot concentrated calcium chloride, is inhibited by adding sodium chromate to the solution.

▶ **Handling Headaches**—Linde encountered several materials handling problems in the pellet forming section of the plant which caused some head-scratching among the engineers.

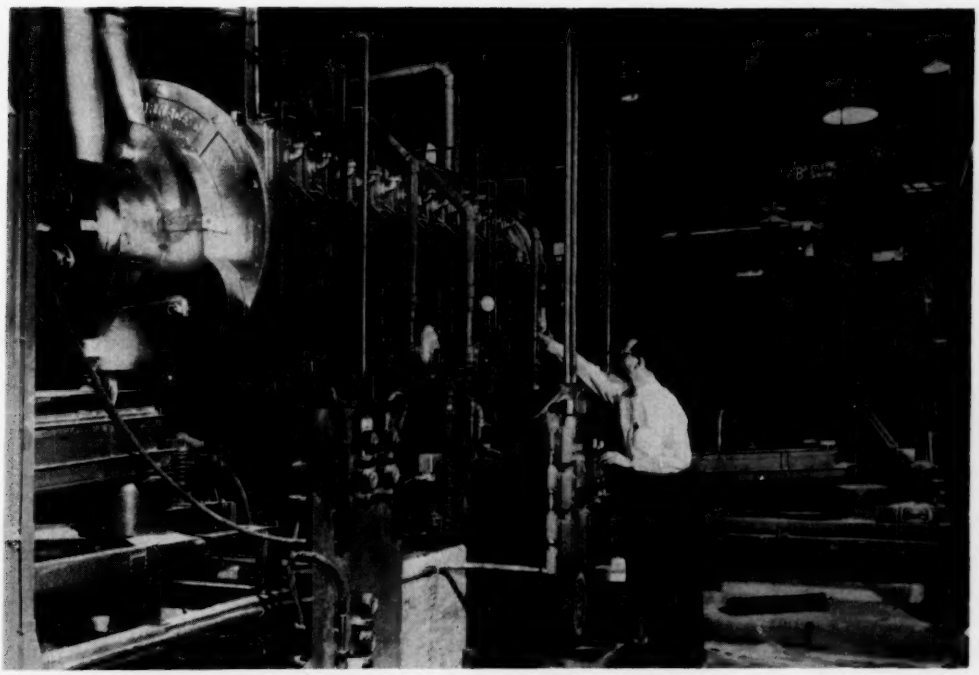
First difficulty was in handling the zeolite filter cake without bridging in the supply hopper. A live-bottom bin with vertical sides solved this problem. Next was the problem of extrusion: Clay-zeolite mixture is dilatant (increases in volume when shape is changed because of wider particle spacing). By carefully regulating moisture content of mixture and by designing a special extrusion head, Linde engineers got out of this predicament.

Handling the moist extruded pellets before they develop strength in the kiln requires belt conveyors plus specially modified elevators and rotary dryer.

tals from mother liquor; filter cake then
d is extruded into molecular sieve pellets.



3 ROTARY DRYER dries the moist sieve pellets to build up mechanical strength before activating in the rotary kiln.



4 ROTARY KILN activates the dry molecular sieve pellets by driving out water molecules from the crystal pores. Remaining voids act as traps for molecules which fit into these crystal spaces.

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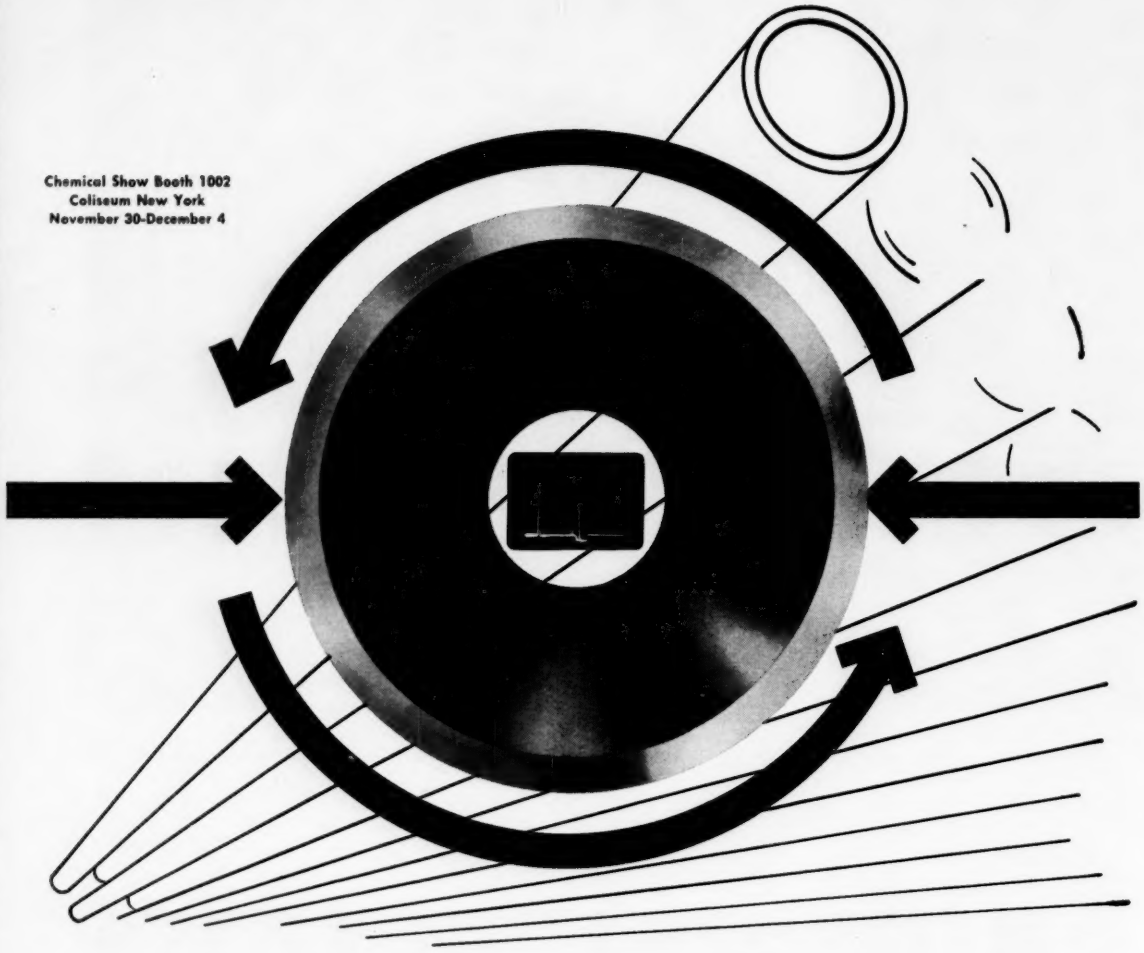

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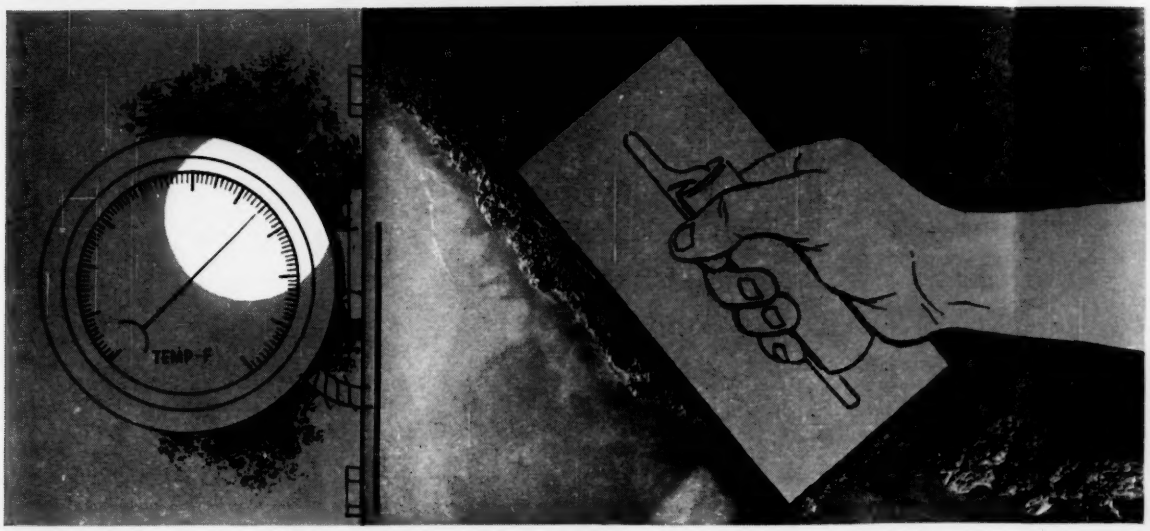

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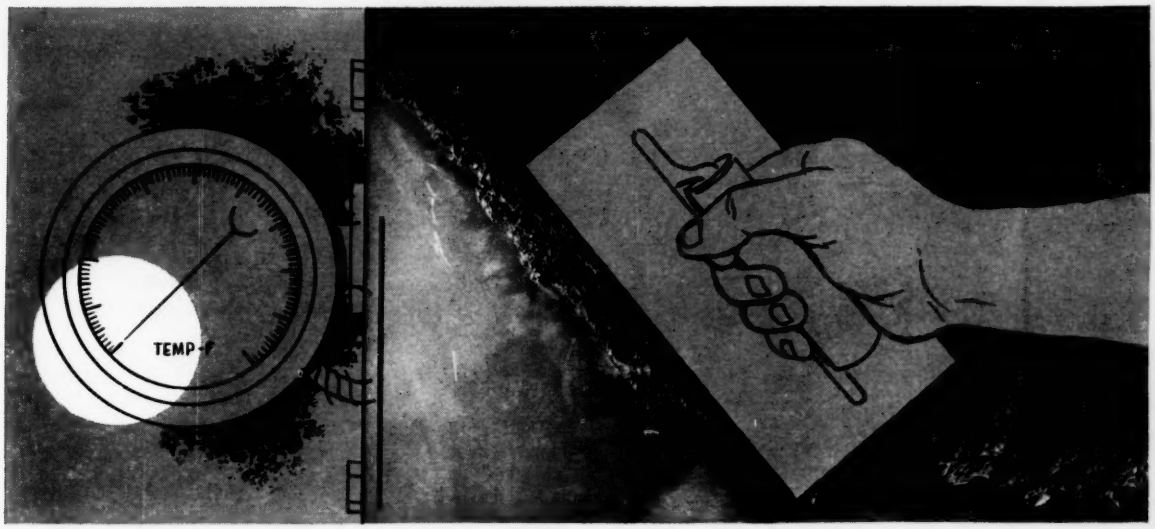

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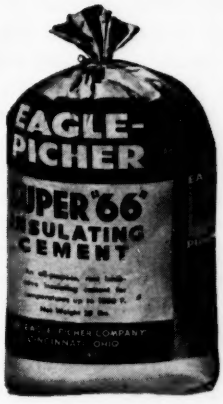

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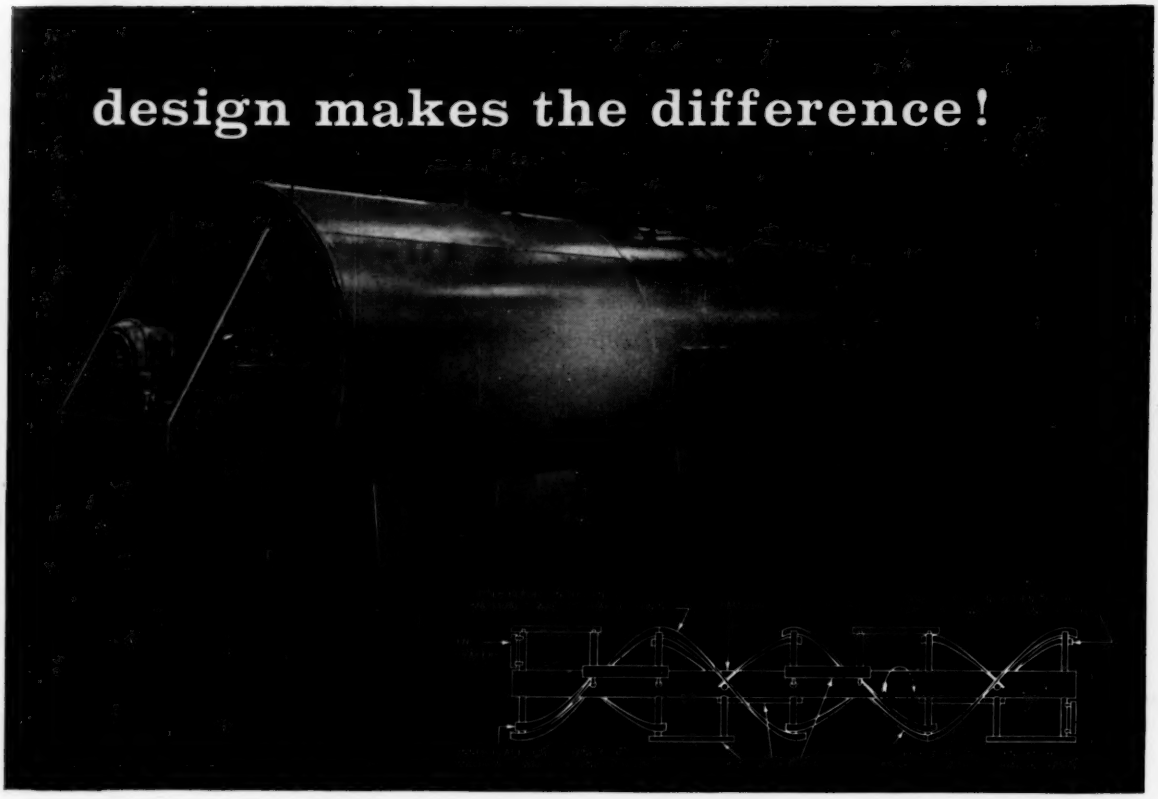

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The double spiral keeps all the material moving . . . continuously mixes and braids it, puts all parts of the load in contact with heated drying surfaces, and eliminates agglomerates. Production is further speeded by the steam-heated agitator shaft and arms, which increase effective drying surface up to 25%. And the smooth, even operation of the entire unit minimizes load fluctuations, keeps power requirements low.

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Functional features like these—the result of Stokes' long experience in designing and manufacturing vacuum process equipment—are found throughout the entire rotary vacuum dryer. Equally important features are built into Stokes cone vacuum dryers, drum dryers and flakers for the chemical and processing industries. In each case, Stokes design is your guarantee of unequalled efficiency and economy.

Stokes Advisory and Engineering Service, with its fully-equipped laboratory, is available to help you solve drying problems and plan for profitable production. For full information, write to Stokes or contact your nearest Stokes office.

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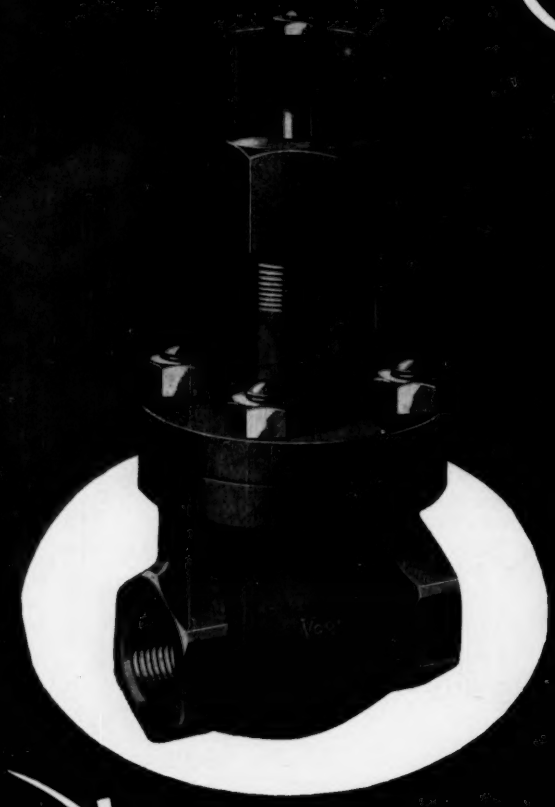

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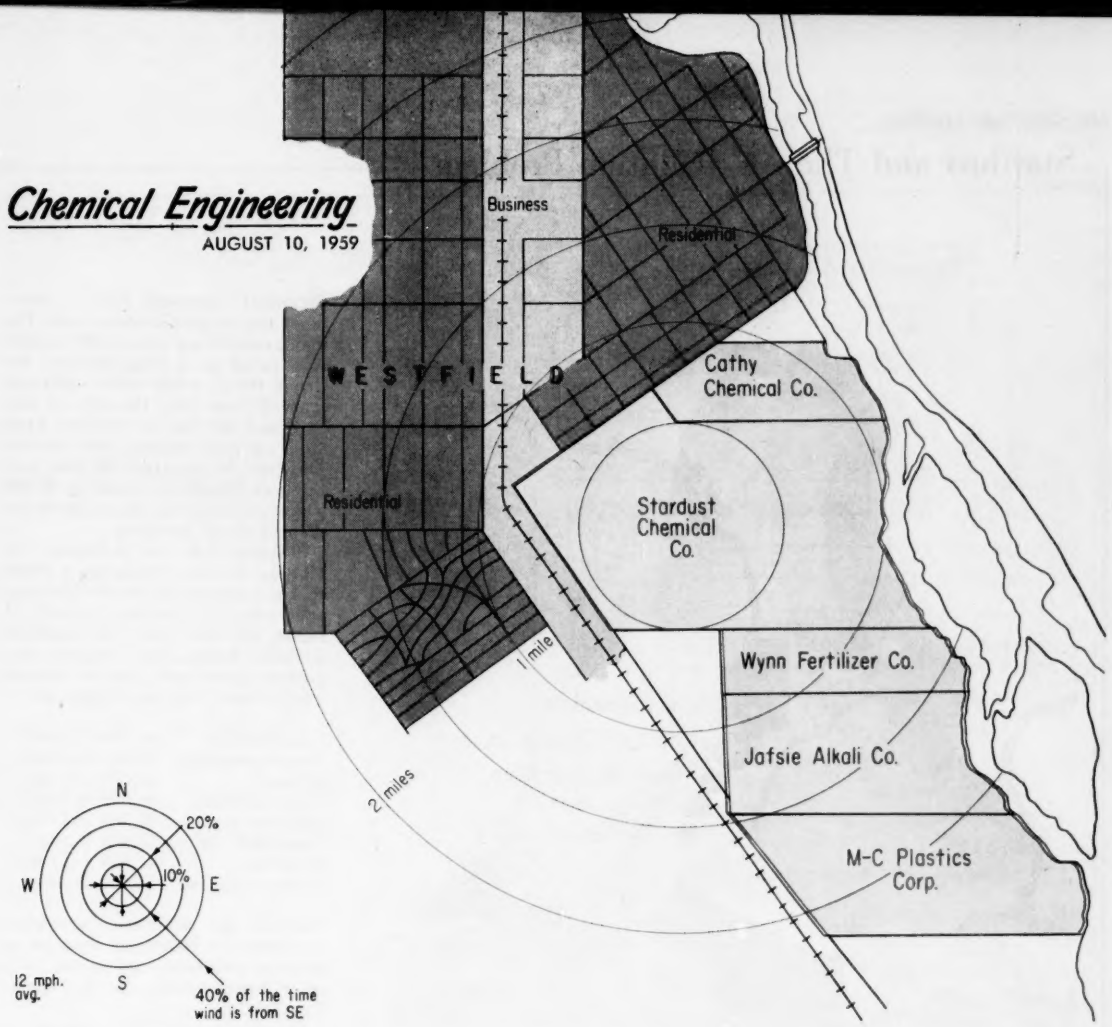
Chemical Engineering
AUGUST 10, 1959

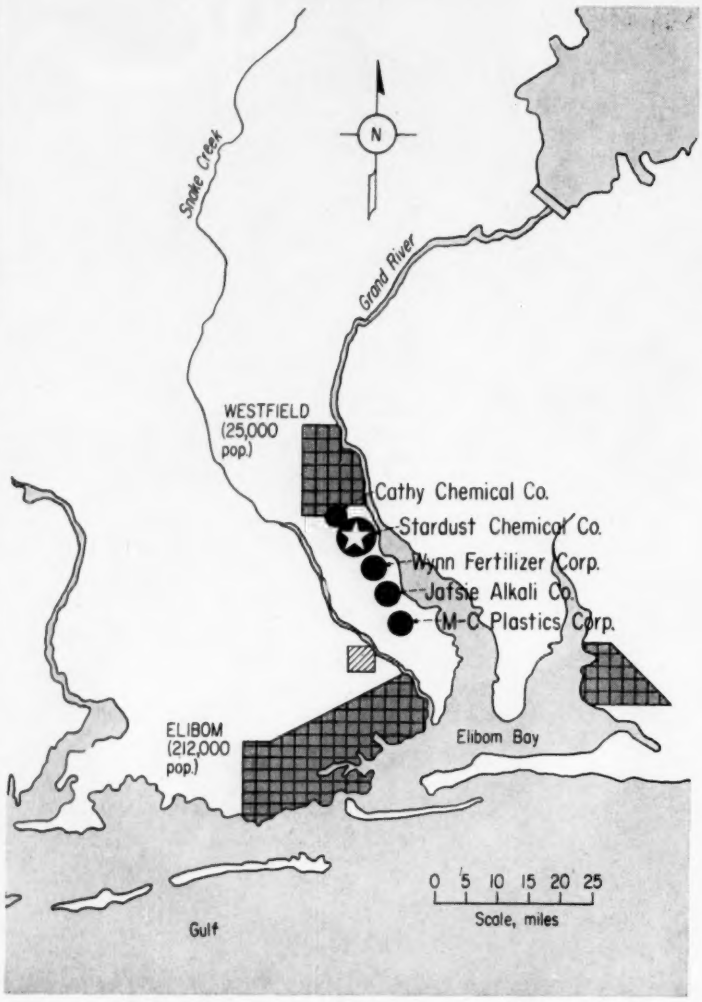


How to Cope With Air Pollution

If you've followed the tangled affairs of Stardust Chemical Co. you know that this imaginary refinery and chemical plant has a faculty for getting into trouble, and then right out again. The trouble now is air pollution but Stardust has the answers.

TWICE before, imaginary Stardust Chemical Co.—a combined oil refining and petrochemical operation on the Texas Gulf Coast—has found itself in trouble with respect to the public. Both of these occasions have ended happily when the progressive Stardust management has called meetings of technical personnel, governmental authorities and the public, and has come up with practical solutions to the problems which were causing the trouble.

—Stardust and The Air Pollution Problem



Stardust Chemical Co. is imaginary but its problems are real. The plant, employing some 2,300 people, is situated on a tidal estuary, the Grand River, a few miles upstream from Elibom Bay, the city of Elibom, and the Gulf of Mexico. Four other process plants are nearby. Stardust is situated on the outskirts of Westfield, a town of 25,000 which provides the labor force for the industrial complex.

Stardust has two divisions, the refining division which has a crude charge capacity of 40,000 bbl./day and a catalytic cracking capacity of 15,000 bbl./day; and the chemical division, which uses refinery by-product gases and piped-in natural gas to make organic chemicals:

Acetaldehyde	**100,000 lb./day**
Acetic anhydride	**75,000 lb./day**
Ethanol	**50,000 gal./day**
Ethyl chloride	**25,000 lb./day**
Ethylene glycol	**30,000 gal./day**
Formaldehyde	**20,000 lb./day**
Methanol	**45,000 gal./day**
Triethanolamine	**10,000 lb./day**

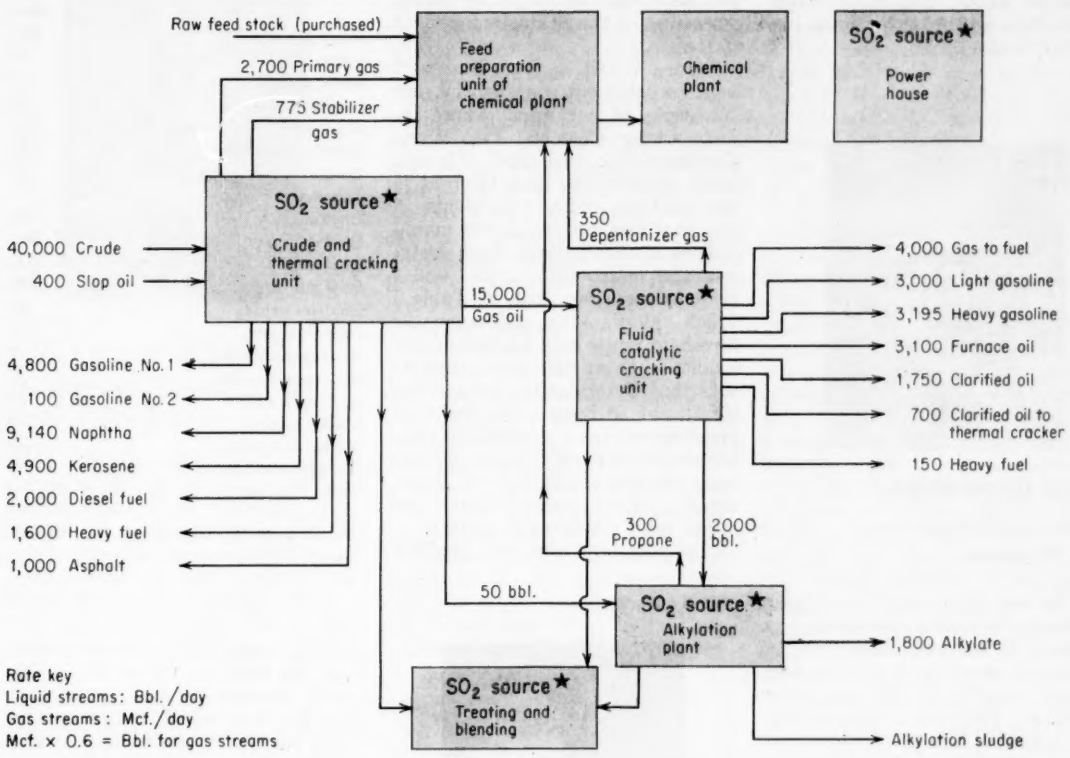
Part of the petroleum division's production is thermally cracked to provide ethylene, propylene and other hydrocarbons for the chemical division.

Stardust's utilities include a 1,000,000 lb./hr. boiler plant, producing steam at 600 psig. which is delivered to process at 200 and 75 psig.; a source of natural gas at 20 c./MM Btu.; and electricity produced in part by the plant's own turbines, and in part purchased from the utility supplying Elibom.

The first of these problems (*Chem. Eng.*, Dec. 1957, pp. 237-252) was a water shortage. In the second case (*Chem. Eng.*, July 14, 1958, pp. 129-140) plant effluents were polluting the nearby river and bay. Now, Stardust's difficulty comes from air pollution. In this, Stardust is not alone, since the area has been growing rapidly and there are now four other process plants within "polluting distance" of the nearby town of Westfield.

These realistic problems have been the concern of the Industrial Section of Texas Water & Sewage Works Association's Short School which is held annually in March at Texas A & M College. As with the two earlier "workshop discussions," we recorded the entire session and bring you here the gist of the 71-page transcript.

Main responsibility for the meeting was in the hands of John F. Conlon, of Union Carbide Chemicals Co., Texas City, who developed the program with the assistance of K. E. Mills and John Keller of American Oil Co. Mr. Conlon, taking the part of Stardust's plant manager, served as moderator of the meeting. He introduced the problem, which was further discussed by representatives of the public and the plant. The official note was added toward the end of the program by representatives of the State Department of Health.



Other Process Plants—Jafsie Alkali Co. (410 employees) makes sodium hydroxide, chlorine and hydrochloric acid. Cathy Chemical Co. (100 employees) makes fine chemicals and catalysts, both organic and inorganic. Wynn Fertilizer Co. (210 employees) manufactures phosphate fertilizers and other agriculture chemicals. M-C Plastics Corp. (625 employees) makes chlorinated paraffins, phenol-formaldehyde resins, modified acrylonitrile polymers and the like.

Meteorology and Topography—Annual rainfall is 27 in. and the prevailing southeast winds average 12 mph. January and July average temperatures are 56 and 84 F. respectively, with maximum and minimum temperatures of 109 and 9° respectively. The topography is flat, with a uniform slope from the coastline inland of 1 ft./mile.

The public's case against the offending industries was presented by Mrs. J. O. Maddox, taking the part of a housewife living near the industrial area to the northwest of the Stardust plant. In real life, for several years Mrs. Maddox has headed anti-pollution activities in the Houston area.

Following Mrs. Maddox's comments, William R. Miles (Eastern States Petroleum & Chemical Corp., Houston), taking the part of Stardust's technical director, summed up the situation. Four members of the plant's technical staff took up specific aspects. These included Robb Y. Rankin (Sinclair Refining Co., Houston) who dealt with the problem of sulfur compounds; John P. Wold (Shell Chemical Corp., Houston) whose subject was hydrocarbons in the plant effluent; Herschel M. Martin (Eastern States Petroleum & Chemical Corp., Houston), discussing smoke and dust problems; and Walter A. Quebedeaux, Jr. (Harris County Health Unit, Houston) who explained the meteorological problems involved.

Finally, to button up the program, the audience heard from the director and associate director of the State Department of Health's Division of Industrial Health. Martin C. Wukasch, associate director, discussed the modern attitude of public health authorities toward air pollution; and in the emergency absence

of the director, Dr. W. L. Wilson, also gave the latter's ideas on the future of public health activities at the state and local levels in air pollution control.

JOHN F. CONLON:
Moderator Introduces The Problem

As IN the 1957 and 1958 Panel meetings, this program is an experiment in workshop technique in which our panel deals with a real problem—applied to an imaginary situation. Stardust Chemical Co. does not exist, but its problems are a composite of those of actual plants and the solutions our panel brings out could easily be real solutions in a real situation.

So now, as plant manager of this hypothetical plant, and as moderator of this real meeting, I want to introduce you to the conditions of the problem (see box, p. 114) and tell you how we will proceed.

Stardust Chemical has grown, the town of Westfield has expanded and several new industries have come into the region since our last meeting a year ago. The public is disturbed by air-borne effluents from our plant and the others—and we are ready and willing to admit our responsibility. Not only that, but five of our panelists are here to tell you what we propose to do about it. However, before they do so, Mrs. Maddox will tell you about the town's complaints. As head of civic groups opposed to air pollution she is active also in national pollution control activities.

Following Mrs. Maddox you will hear from our plant technical director and four of his specialists who will show you how we expect to cope with the problem. And finally, the public health and state viewpoints on air pollution control will be presented to us by representatives of the State Department of Health.

Before I call on our experts I want to point out some of the new industries of our area. These include Cathy Chemical Co., Wynn Fertilizer Co. and M-C Plastics Corp., all of which have brought in new products and new problems. A new Stardust activity is the manufacture of acrylonitrile from acetylene and hydrocyanic acid. And I want to have you look at Table I which shows the tolerance or threshold limits on a number of pollutants—but at the same time to note that these figures are not too significant in community pollution problems where the offending materials are generally poorly defined and complex mixtures of gases, vapors, mists, fumes, dusts and other solid particulate matter.

And now, let's hear Mrs. Maddox.

Threshold Limit Values of Gases and Vapors—Table I

	Ppm.
Acetaldehyde	200
Acetic acid	10
Acetic anhydride	5
Acrylonitrile	20
Ammonia	100
Carbon monoxide	100
Carbon tetrachloride	25
Chlorine	1
Ethyl alcohol	1,000
Ethyl chloride	1,000
Ethyl ether	400
Ethyl mercaptan	250
Ethylene oxide	50
Formaldehyde	5
Hydrogen chloride	5
Hydrogen cyanide	10
Hydrogen sulfide	20
Methyl alcohol	200
Methyl mercaptan	50
Nitrogen dioxide	5
Sulfur dioxide	5

From AMA Archives of Industrial Health, August 1958.

MRS. J. O. MADDOX:
Housewife Defines Town's Pollution Difficulties

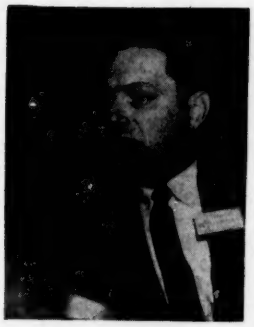
MR. MODERATOR and gentlemen: I want to start out by saying that neither I nor the Allied Civic Clubs of Westfield, which I represent, are anti-industry. We need the local industries and they need us. But we do want you to know how this air pollution problem affects the people of the town and we want to help, if possible, to work things out so industry and the people can live together as good neighbors.

As you know, Westfield has been expanding, mostly toward the industrial area. Our homes and our many schools and churches lie to the north and northwest of the industrial area, which, unfortunately, is in the direction of the prevailing wind. On occasion we are subjected to a fine dust which settles on and mars our furniture, to smokes and odors, to fumes which discolor paint and sting the eyes, nostrils and throat. Without much imagination we can, from time to time, detect the odors of skunks, dead rats, rotten cabbage, dead fish—and sometimes a sweet and nauseous medicine odor.

Sometimes a soot-like substance settles on our washing, which has to be done over again. After a bad spell of the fumes we'll find our plants wilted and our trees losing their leaves. Sometimes we have had a sort of fog, when there was no natural fog about, which would leave rusty spots on cars and disintegrate clothing, especially nylon dresses and hose.

In fact, gentlemen, the odors are often so bad that we can't use our back-yard barbecues to entertain, as many of us like to do.

Moderator: Thank you, Mrs. Maddox, for your realistic picture of the situation which industry can create. I am going to call on Mr. Miles, our technical director, who has been studying the problem in detail. He and his staff will tell us what they have learned of ways to cope with the problem.



WILLIAM R. MILES: Stardust Has Already Made a Good Start

WE ARE grateful to Mrs. Maddox for painting this picture of the air pollution picture in Westfield, even though it's a rather grim picture and a true one. In defense of Stardust, I must say that many of the things that have happened did not originate in our plant. But as the oldest and largest industry in the region, it is evidently up to us to take the lead in improving the situation. And this, as you will see, we have been doing.

However, until recently, the air-pollution control setup in our plant has been on a more or less hit-or-miss basis. We had people from the laboratory, from engineering, from the safety staff, and even from management, investigating pollution complaints and handling them on a part-time basis. Without a central setup and definite responsibility, much information was lost or not properly taken care of.

Now we are establishing a special department which will devote its efforts on a full-time basis to pollution and the problems it causes. This department will have its own laboratory and own engineering so that it will be able to make tests and develop new control equipment. It will be able to find out exactly what's in the air and what harm it may be doing. It will be in a position to get and act on complaints.

I want to emphasize that we welcome complaints. They are the way we know when our neighbors are being troubled because, as you know, the people here in the plant tend to become relatively immune to the odors we produce—they're surrounded by them continuously.

As is true with most chemical process industries, we handle a great many odorous materials. We'll have to admit to two kinds of air pollution problem: dusts and other particulate matter, and fumes from both organic and inorganic chemicals. Many of the odorous materials are sulfur compounds—sulfur dioxide and trioxide, hydrogen sulfide, mercaptans, other sulfides. We also make or handle aldehydes, ethanol and methanol, acetic anhydride, triethanolamine, formaldehyde, ethyl chloride, ethylene glycol, ethylene and others. We don't have much of a smoke problem since making some improvements you will hear about, but we do have dust from our fluid cat crackers and to some extent from our parking lot and unimproved areas.

Who the Panel Members Are

JOHN F. CONLON (Moderator)—Staff Engineer, Works Eng'g Dept., Union Carbide Chemicals Co., Texas City, Tex. Received BS and ChE from Columbia in 1933, then joined Carbide at South Charleston. Since 1952 in Texas City, Conlon has been active in AIChE and ACS, especially in pollution control activities.

MRS. J. O. MADDOX (Spokesman for the public)—Lives in Houston and for several years has been a leader in the fight on air pollution for which she has been widely recognized on several occasions. A member of the Southeast Section of the Air Pollution Control Assn., she was chairman in 1958.

WILLIAM R. MILES (Technical Dir.)—For the last four years, chemist in charge of the air and stream pollution abatement program of Eastern States Petroleum & Chemical Corp., Houston, Tex. Received his BS in chemistry and bacteriology from LSU in 1947. Is experienced in industrial bacteriology and pollution work.

ROBB Y. RANKIN (Plant Technical Staff)—Head of the Utility Div. of Sinclair Refining Co.'s Houston Refinery. After receiving his bachelor's degree from Rice Institute in 1930, he went to work for Sinclair in Houston. He has worked in both technical and operating departments, as well as utilities.

JOHN P. WOLD (Plant Technical Staff)—Senior Technologist with Shell Chemical Corp., at Houston. A native of North Dakota with degrees from the Merchant Marine Academy, North Dakota A. C. and MIT he has split his time since 1950 equally between U. S. Public Health Service and Shell Chemical.

HERSCHEL C. MARTIN (Plant Technical Staff)—Manager of Refineries, Eastern States Petroleum & Chemical Corp., Houston, Tex. After receiving his BS in mechanical engineering in 1941 he joined Eastern States but went shortly into military service. Returning in 1945, he advanced to chief engineer, then to his present job.

WALTER A. QUEBEDEAUX, JR. (Plant Technical Staff)—Director of Stream and Air Pollution Control Section of Harris County Health Unit, Houston. Dr. Quebedeaux holds degrees in chemistry, chemical engineering and mathematics. Most of his work since 1940 has been in some aspect of air or stream pollution control.

MARTIN C. WUKASCH (Texas State Department of Health)—As Associate Director of the Division of Occupational Health, Mr. Wukasch is in charge of ionizing radiation, air pollution control and environmental hazards programs. His BS in ChE came from the University of Texas in 1941. He earned an MS in Public Health in 1950.

WILLIAM L. WILSON (Texas State Department of Health)—Director of the Division of Occupational Health, Dr. Wilson was for 30 years in the U. S. Army Medical Corps, retiring in 1956 as a brigadier general. His early education was at Southern Methodist and Baylor. In 1947 he received a masters in Public Health at Johns Hopkins.

Strangely enough, at one point and under some conditions we even have a problem with water vapor.

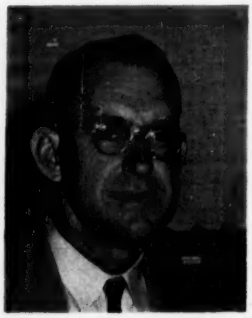
We have already completed several improvements which have eliminated complaints and we have plans for the elimination, or at least the major reduction, of all other recognized points where pollution trouble can originate. I'll tell you about some of these and my associates will go into detail on the projects still in the plan stage.

What are the things we have already done? A rather minor item from a pollution standpoint was to replace several cone-roof tanks for our crude-oil storage with floating-roof tanks. You will hear more of this from Mr. Wold. We no longer burn our acid sludge, which used to be a bad actor. Instead we now sell it to a chemical company for regeneration, but even this often releases some SO_2 at the loading dock and we have a project to take care of that. And we have made changes in our flares which formerly could smoke badly under unfavorable loading conditions. Mr. Martin will tell about this and also about our plans for greatly reducing the dust from the cat crackers.

Hydrocarbon odors can originate at several points. Mr. Wold will explain our plans to cure these. For example, we intend to install a catalytic combustion unit to take care of odor from the formaldehyde and methanol plants. Special furnaces and burners will take care of some of the other hydrocarbon problems.

Probably our biggest difficulty comes from H_2S and SO_2 and by far our biggest project will be the one required to eliminate this problem. Mr. Rankin will give you the details but I want to point out how the problem comes about in the first place.

If you will note the plant layout and material balance chart shown on p. 115, you will see the five stars that mark the main points where SO_2 can be given off. Starting with the crude unit, we process a very sour crude and produce a lot of waste gas containing H_2S and SO_2. We use over 30 MM scfd. of gas, about a third from crude processing and waste oil, so our power plant can be a major source of SO_2 in burning these fuels. Again, our cat cracker, our alkylation unit and our treating and blending plant are all sources of H_2S or SO_2. True, the sulfur compounds must be stripped in diethanolamine absorption towers from the gases going to chemical manufacture, but this does not solve the SO_2 problem since, in regenerating the DEA, we get off H_2S which at present must be burned. So, let's hear what Mr. Rankin has to say about our proposed solution of the SO_2 problem.



ROBB Y. RANKIN:

Proposed Sulfur Plant Can Make a Profit

You have heard from Mr. Miles that Stardust has a sizable problem of disposing of H_2S and SO_2 without venting to the atmosphere. However, he didn't tell you what the solution is going to be. When you see the quantity of sulfur going through the refinery, as shown by Table II, you will realize that the answer is almost self-evident—a sulfur-recovery unit. Note in the table that the sulfur comes primarily from four particular sources, although there are some secondary sources that feed into these.

The DEA absorption units in the chemical feed preparation plant take out almost 47,000 lb. of sulfur per day in the form of H_2S. The next biggest source is the fluid catalytic cracking unit where there is 27,000 lb. per day. Two small sources, each the equivalent of about 200 lb. of sulfur per day, are unimportant from the sulfur recovery standpoint, but are a sufficient pollution problem to be included. These are the SO_2 loss when spent alkylation acid is loaded into barges; and H_2S now sent to the boilers from the steam stripping of waste waters containing sulfides.

The meeting will recall that this steam stripping operation was introduced last year to cure a water-pollution problem—but, in so doing, it created an air-pollution problem; this often happens in such cases.

Going back for a moment to that 47,000-lb. sulfur source, the chemical feed preparation plant contains four diethanolamine absorption units which clean up the streams of primary gas, stabilizer gas, gas from the depentanizer and the propane stream from the alkylation plant. We shall need still another DEA absorber for the cat cracker stream, as well as a new stripper for this stream. This will be similar to the existing stripper and will simply be a steam-heated reboiler using 45 psi. steam. The combined H_2S streams from the two strippers will flow through a heated aluminum line to the new sulfur plant—aluminum to take care of the severely corrosive condition; heated to prevent formation of condensate.

There is one problem with the DEA absorbers which is going to need some additional investment. The sulfur-rich primary gas stream is at about 130 F. when it contacts the lean DEA at 110 F. Without some initial cooling of the rich gas stream, the cooler DEA will pick up so much hydrocarbon that our sulfur plant will fail to function, either from catalyst fouling or through disturbance of the air ratio for burning H_2S.

The sulfur recovery method we plan to use is the Claus process illustrated in the accompanying diagram. This shows both the flow diagram and the equations. Here about a third of the H_2S is burned to SO_2 which then reacts over a bauxite catalyst to form water and elemental sulfur. We may decide to put in a waste-heat boiler after No. 1 burner to generate 125-psi. steam for the plant. The gas stream from this burner goes to No. 1 converter at about 450 F. which keeps the sulfur formed just above its dewpoint and therefore in vapor form until it reaches the first cooler. Here 45 to 50-psi. steam is produced in cooling the vapor and molten sulfur is drawn off.

The gases pass from the first cooler to the second H_2S burner to rebalance the necessary H_2S-SO_2 ratio and then to the No. 2 converter. Here the outgoing temperature is about 550 F. The gases and sulfur vapor are again cooled in a unit which we'll probably use to

Sources of Sulfur—Table II

Source	S, Lb./Day
Feed preparation	46,700
Catalytic cracking	27,300
Spent alkylation acid	200
Sour water stripping	200
	74,400

Sulfur Plant Investment—Table III

DEA absorber for fluid plant	$75,000
New DEA stripper	75,000
Sulfur recovery plant	350,000
3,000 gpm. cooling tower	44,000
Revamp sour water stripper	12,000
Barge-loading blower	15,000
Equipment cost	$571,000
Install., fees, etc.	810,000
Total cost	$1,381,000

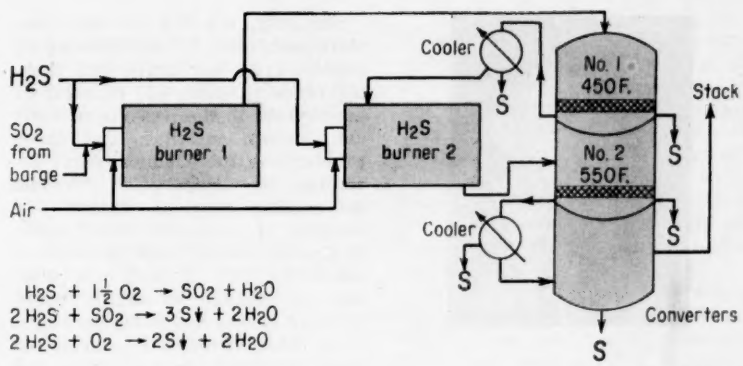
Sulfur Plant Operating Cost—Table IV

	$/Day
Labor	75
Maintenance	150
Steam	40
Electricity	20
Water	11
Fuel	10
Chemicals & supplies	50
Taxes, insurance, miscl.	140
Total operating cost	$496

Sulfur Plant Net Return—Table V*

	$/Day
Sulfur sales	769
Savings on corrosion	450
Total return	1,219
Operating cost	496
Net return	$723

*Payout approximately 5 years.



heat the boiler feedwater. The flue gases, together with any remaining sulfur vapor, flow to a coalescing chamber where the last traces of vapor are removed. Residual gases pass to an incinerator and stack provided mainly to take care of any H_2S which might remain in the gas stream due to irregularities in operation or a possible power failure.

You will note from the flowsheet that the molten sulfur is drawn off at five points. It flows to storage tanks beneath the foundation where it is kept melted ready to be pumped to shipment.

Utility requirements for the plant will include about 600,000 lb. per day of steam. The waste-heat boiler on the first burner should provide about 360,000 lb. per day, the coolers some 110,000 lb. of 45 to 50-psi. steam. The plant will need a water-cooling tower for about 3,000 gpm. and will take about 325 kwh. of power per day.

Referring back to Table II, we see that the sulfur available comes to 33 long tons per day. At a recovery efficiency of 95 or 96% we can expect to make about 31½ tons per day, worth about $25 per ton.

Earlier we mentioned two small pollution sources, the barge-loading and sour-water-stripping operations. When an acid barge is loaded with acid sludge, mixing of the sludge with any acid already present sends out a cloud of SO_2 fume. We propose to add a blower at the loading dock to pump this fume back to the sulfur plant. And the H_2S stream from the sour-water stripper will be piped to the sulfur plant instead of the boiler house, since we believe this gas can be handled without trouble. Our most likely difficulty is that hydrocarbons in the alkylation acid may come off with the SO_2. We have already seen that hydrocarbons can cause trouble in the sulfur plant. However, the quantity from this source should be small and we believe that with care we can handle it by control of the H_2S-SO_2 ratio.

In Table III we have listed the amounts of money needed to put these plans into effect. The $27,000 for recovering sulfur from the stripper and the barge loading is out of line from the investment standpoint, of course, but is a small factor in the whole investment and, we believe, not too much to pay for clean air.

Tables IV and V show the anticipated operating cost and net return for the sulfur plant. One operator per shift, and probably only part of a day foreman's time, will be needed. Operating cost of $496 per day will be balanced against sulfur sales of $769 per day. However, owing to reduction in the extreme corrosion we've been experiencing, we feel we can give the sulfur plant an added credit of at least $450 per day in reduced maintenance. So it works out that we'll have a net return of some $723 per day—about a five-year payout. Although this is not very good compared to what we expect from normal processing investments, it compares favorably with utility investment payouts—and it is excellent when you consider that it is actually a pollution control measure.

Question: How can you justify such a large credit for reduced corrosion and maintenance?

Rankin: Well, just to mention one item, we use air preheaters on some of our furnaces. When they do an efficient job they get the outgoing stream down to 250-300 F., which means condensation and severe corrosion from the SO_3 and SO_2 present. These preheaters cost around $50,000 each and we have found that to replace 70% of the elements in one will come to $20,000 or $30,000. We expect to eliminate most of such maintenance, as well as control valve stoppages and boiler economizer corrosion.

Moderator: And now we'll hear from Mr. Wold about proposals for coping with hydrocarbon fumes.

JOHN P. WOLD:
Curbing Hydrocarbon Losses Will Cure Many Complaints

SINCE we have been having complaints about odors and the marking of vegetation around the plant, we decided to make a survey to find whether solvent and hydrocarbon fumes were causing air pollution and, if so, what the sources were.

We found four principal sources including: (1) vents from atmospheric storage tanks and vessels; (2) leaks from pumps, valves and packings; (3) relief valves on our emergency relief system; and (4) continuous process vents from columns and reactors. The last, continuous process venting of aldehydes, mercaptans and ethylene, was found to be our principal trouble source. Except for smoke from the flares, the tankage and emergency relief systems are not producing air pollutions problems.

Our study showed that there is no single expedient solution to the whole problem. Solvent and hydrocarbon fumes are emitted at numerous points and in widely varying concentrations and quantities. One might think that all fume sources might be tied into one of the existing flare systems and the material disposed of by combustion. However, this isn't possible.

The flare systems in both refinery and chemical plant are there for the express purpose of protecting the process equipment. At present, when one of the relief systems operates, pressure in the relief headers to the flares goes to 25 psi. Tying in other systems could be dangerous and might result in rupture of such equipment as the atmospheric storage tanks. So our individual problems will require individual solutions based on sound engineering principles.

Basically, we find we have five main problems: (1) air-blowing of asphalt from our crude and thermal cracking units; (2) emission of mercaptans in the treating of light cat cracker gasoline; and three problems in the chemical plant including (3) discharge of ethylene in making ethylene oxide; (4) venting of aldehydes in a waste hydrogen stream when process upsets occur; and (5) a chronic problem of leakage of amine odors through blower and pump packings.

In Table VI we have summarized these problems, their solutions and the costs involved. Let's consider them one at a time.

In our refinery we produce about 1,000 bpd. of asphalt which is air-blown in a remote section of the refinery. For this we use about 25,000 scfh. of air. Using snuffing steam on top of the oxidizer, the vapors leaving the oxidizer are below the lower explosive limit. The vapors are mainly air with some aldehydes and other materials with a burnt-tar odor.

As a permanent solution we propose installing a burner in a refractory-lined vessel equipped with a flare stack. If we maintain the stack temperature in the range of 1,100-1,400 F. we can incinerate the aldehydes and other organics. We have selected this method in lieu of catalytic combustion, first because it's cheaper, and second because, during process upsets, mist droplets carry over and could foul the catalytic unit. As Table VI shows, we believe $12,000 should cover this improvement.

Solution to our mercaptan problem is simpler. We have been selling the spent caustic from the treatment of our light cat cracker gasoline to a cresylic acid manufacturer. He has insisted on our eliminating the mercaptan content which we have done by air oxidation. In this operation we have been stripping mercaptans equivalent to 100-180 lb. per day of sulfur. This has gone into the atmosphere. We've tried to control the odor by odor masking but this hasn't been very satisfactory, especially during periods of rainfall and high humidity.

The permanent solution we propose is to install a knock-out pot and flame arrester, and make one small process change—to operate the air oxidizer and accumulator at 15 psi. This will give enough driving force to get the gases to a nearby furnace. The small cost of $3,500 is mainly for the flame arrester and pipe. If we were unable to increase pressure on the vessel and had to install a blower, the cost could easily be three times as high.

Now, let's look at the chemical plant problem. In manufacturing ethylene oxide at Plant 3, we are venting 800,000 scfh. of air from a reactor under pressure. This vent contains 1¼% of ethylene and about 2% of ethane. During periods of abnormal air circulation it is quite likely that some of this ethylene reaches the ground and causes marking of vegetation.

As a permanent solution to this problem we propose to install a pressure catalytic combustion unit. The unit itself will cost about $25,000, while piping and installation will bring the total to $50,000. We'll have to have a starting heater to bring the gas to 450 F. initially but once started the combustion of the ethylene and ethane will preheat the incoming gas to maintain combustion. Outgoing gases will be under pressure at 1,300 F. In the future, if we need additional steam, we can put a waste-heat boiler ahead of the stack and recover 50-psi. steam from this unit.

Projects for Curing Hydrocarbon Pollution—Table VI

Pollution Source	Quantity	Cure	Cost, $
Asphalt blowing	25,000 scfh.	Gas burner	12,000
Regen. spent NaOH, mercaptans	100–180 lb./day sulfur equiv.	Furnace	3,500
Ethylene losses	1¼% in 800,000 scfh.	Cat. combust.	50,000
Aldehydes in H_2 vent	3,000 scfh.	New flare	8,000
Amines from leaks	.....	Mechanical seals on pumps	5,000
			$78,500

Our second chemical plant problem is a hydrogen vent in Plant 5. This normally runs about 3,000 scfh. and contains very little aldehyde. During startup and operating upsets, however, the aldehyde content can go much higher. The existing flare stack for this operation has a steam snuffer for controlling the flare fire. For a permanent solution we propose to revamp the existing flare stack, adding a knock-out pot and flame arrester, and a new flare tip of Hastelloy, equipped with a spark-plug ignitor. By maximum utilization of the existing flare facilities, we can keep the cost down to $8,000. Otherwise, it could come to several times this figure.

Checking into Plant 7 we found that all major vents are hooked up to a relief system but that need for maintenance, especially for this system's blower, has been cancelling out the protection against odor it was supposed to give. Also, in this plant, our pump packing has been a chronic problem and contributes to amine odor leakage. In addition to repairing the blower we propose a program to substitute mechanical seals for the pump packing—to cost about $5,000.

Summing up the several projects for curbing hydrocarbon fumes, the entire job can be kept to about $80,000 if we make maximum use of existing facilities. We can have all construction finished about 40 weeks after the money becomes available.

Mr. Miles mentioned that we had substituted floating roofs in the tank farm for some of the cone-roof tanks. In general we find that our tank farm practice is in accord with plant standards for the storage of volatile materials. We store highly volatile materials in pressure tanks, intermediate volatiles in floating-roof tanks, and the least volatile materials in cone-roof tanks equipped with conservation vents. The latter are set to open at 2½ oz. positive pressure, or 1¾-in. w.g. vacuum. However, we did find this: that sometimes conservation vents have been removed for repair, but not replaced.

We have four recommendations for reducing vapor losses in the tank farm—that the missing vents be replaced; that all gray, silver and black tanks be painted white to reduce vapor loss by about 30%; that the vapor spaces of rundown and finish tanks be connected so far as possible for vapor exchange; and finally that we go to diaphragm valves rather than packed-type valves so far as possible in handling odorous materials. With these and our other recommendations carried out, I'm sure that the bulk of our hydrocarbon pollution problems will have been solved.

Moderator: Mr. Martin, what can you tell us about the dust and smoke problem at Stardust?

HERSCHEL M. MARTIN:
Cat Cracker Cleanup Will Show Good Return

WE HAVE some very real problems at Stardust but I'd like to point out that as an employee of an imaginary company I have a big advantage over the rest of you in wangling money out of my imaginary management. It's safer, too. Also, I'd like to mention one interesting point brought out by Mrs. Maddox before I get into my own topic of smoke and dust. I've noticed that most of our smoke problem seems to occur on week ends and we haven't been able to tie it down. I think perhaps if we stopped those back-yard barbecues she mentioned we would have the smoke problem about licked!

When we think of smoke we naturally think of fire. In our refinery and chemical plant we have dozens of fires and we burn millions of cubic feet of gas every day. The important thing is that we burn all that gas without a trace of smoke, because that's the economical way to burn it, and we designed our equipment for economy.

I must admit that our waste gas flares are another matter. The purpose of a flare in a refinery is to take care safely of some happening —some equipment or some human failure—which will release a lot of hydrocarbon materials to the relief system. Historically, flares have been built for just one purpose—to be able to take a large and unknown volume of unknown composition and burn it so something else won't blow up. Until five years or so ago, nobody paid much attention to smokeless combustion for flares.

Now, I'm glad to say, there is a fairly simple and cheap solution which is in use pretty generally throughout the refining industry. This is to inject steam or a water spray into the base of the flame to induce the proper air flow into the combustion zone. In our own case, our maintenance people ran a few hundred feet of 2-in. pipe and broke it down into some 1-in. fog nozzles arranged around the base of the flame. This system really works. Without automatic control, as in our case, it costs about $3,000 to install.

The only trouble is to make sure that there's an operator around to turn on the water in case the flare starts smoking.

The dust problem is not quite so easy. Today, most refineries are operating fluid catalytic crackers. The tons of catalyst in such a unit have a consistency about like talcum powder or flour and in the regenerator, where we burn off the carbon deposited in the cracking step, we must contact it with about 30,000 cfm. of air at about 8-9 lb. pressure. Naturally, you whip up quite a sand storm and the dust-collecting multiple cyclones at the top of the unit have a difficult job in catching the catalyst while letting the air go out to the atmosphere.

Our particular unit consists of 48 cyclones in parallel, each 12 in. in diameter. Air from the cyclones goes through a 5-ft. duct to an electrostatic precipitator which seems to be doing as good a job as possible, but some 2 tons of catalyst per day is getting by. We don't know whether this really constitutes a pollution problem since we have never been able to find any definite traces of it settled on the ground. However, people can see it and they *believe* it to be a pollution source—which in itself is enough reason for us to do something about it.

Our collection system is typical of those put up during World War II. Many have been changed since.

We have had the matter up with an engineering concern who recommend two *series* of five 4-5-ft. diameter cyclones in place of the small-diameter cyclones in parallel. The job will cost $75,000 or less and is guaranteed to cut the loss to ¾ ton per day. At $300 per ton for catalyst, this means a $375 per day payout, which should be very attractive to management.

Once we get the appropriation it should take about six months to get the equipment and install it. Meanwhile, our public relations staff will want to tell the public what we are planning and will naturally want to stress the fact that we'll be taking 1¼ tons of catalyst from the air stream every day—rather than that we'll be leaving ¾ ton in.

Moderator: If there are no questions we'll ask Dr. Quebedeaux to discuss the meteorological questions involved in these problems.

WALTER A. QUEBEDEAUX: Gas Cleanup, Not Tall Stack, Is Stardust's Aim

IF YOU will go back to your detail map of Westfield (p. 113) you will see that the prevailing wind is from the southeast. Well, there are other plants to the southeast of *us*, and I don't think we should accept responsibility for types of pollution which could not possibly emanate from our plant. For example, we have spotted what is obviously fluoride damage in Westfield—and we have no fluoride-producing operations. I'm sure our sister industries will do what they can to correct their own problems along with us, if we only take the lead.

But, here's a peculiar one for which we must assume responsibility. We have a cooling tower near the intersection of two highways northwest of the plant. If the wind is right we get a fog of cooling-tower water crossing one or the other of the highways and sometimes this fog will pick up SO_3. This makes it heavy so that it settles and creates quite a problem of highway safety. The solution we propose is actually to relocate the tower back near the Grand River. The moving will cost about $5,000 but we'll get some advantage from shorter piping.

A few years ago we had some bad dump and oil-sump areas around the plant which I'm happy to say have been cleaned up. Some of the slop oils have a fatty acid content. And we used to dump certain catalysts and let them disintegrate with the production of some pretty foul odors. Now, by building a larger sump for the slop oils and keeping the material hot—and hence liquid—we can siphon it off and sell it profitably.

One thing we have learned about our particular area is that a tall stack is not the answer to our problems. Our ceiling varies from somewhere around 50 ft. at night to as high as 5,000 ft. during the day—though it will average 3,000 ft. during daylight hours. This means we have a sort of lid on attempts at pollution control by dispersion. This area is a largely flat lowland and we don't have the problem experienced in sections ringed by mountains, but we do have the problem of once-through passage of contaminants. Since we don't have much lateral mixing, we don't get much dispersion. So, rather than depend on a stack, we believe a much better way is to remove offending material before it gets to the stack.

Comment: I'd like to underscore the speaker's remarks about the absence of a ring of hills as compared with sweeping flat ground. Frequent high humidity and low overhang tend to concentrate fumes and dust in this flat country in much the same way a ring of hills would operate. However, I should emphasize that this may not be true in other flat sections of the country.

Miles: Well, you have now heard what we propose to do. It comes to around $2 million and our next problem will be to sell it to our management.

Moderator: I think the time has come for me to summarize a little. We have looked into a great many proposals. All of them should be of benefit to the community in that they will help in controlling air pollution. They'll be useful to us from a public relations standpoint, though it is difficult to put a money value on public relations. Finally, several of the suggestions will show a return on the investment which will make our task of selling management much easier.

However, we feel that management will recognize that neither public relations nor monetary return are the only criteria justifying such expenditures as we propose. Throughout the country there is a spreading movement toward new legislation designed for the specific control of air pollution. Such legislation may be imminent in our own state and therefore one of our objectives should be to insure that our own measures fit in as well as possible with whatever may happen in a legislative way.

There is another move we intend to propose which will not involve any extensive capital expenditure. As we mentioned before, as the largest and oldest of the industries near Westfield, we feel it is up to us to take the lead in establishing an area technical committee which will investigate complaints of air and stream pollution, pinpoint the source, and put it up to the offending plant to correct the condition. We suggest that the committee be activated by the county health officer and that it consist of representatives of each industrial firm in the area.

A moment ago I mentioned the possibility of future legislation. So that we can learn more about the public health point of view, and perhaps also something about legislative possibilities, we have invited Dr. Wilson and Mr. Wukasch of the State Health Department's Division of Occupational Health to speak. At the last moment a Senate group preempted Dr. Wilson's time so Mr. Wukasch will give both his own and Dr. Wilson's talks.

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MARTIN C. WUKASCH:
Health and Air Pollution Are Closely Related

AIR POLLUTION is mainly a health problem although sometimes agriculture is concerned, or there may be economic loss—say, from corrosion—or esthetics may suffer. At any rate, we think of it primarily from the health standpoint and we can correlate it pretty closely with our increasing industrialization and rise in the standard of living.

But, if our increasing standard of living has brought air pollution as a byproduct, it has also brought a demand for something better than polluted air. During the last century, a smoky industrial area was a sign of prosperity. But, today, our ideas are different. In the last two decades some of the smoky cities of the past such as St. Louis and Pittsburgh have largely solved their soft-coal problems.

It was only in 1950 that we had the first nation-wide conference on air pollution. It is true that smoke prevention has been of concern for quite a time but air pollution control in its broad aspects is relatively new. I'd say we are three or four decades farther ahead in stream pollution control than we are in controlling air pollution.

There are several ways of looking at air pollution from a physiological standpoint. One is the exposure. In the course of a day each of us takes into his lungs over ten times as many pounds of air as his combined food and water intake. We have done a great deal to control food and water quality—but, so far, very little with air purity.

Another viewpoint is location. Most of our air pollution problems are associated with the 174 principal metropolitan areas of the United States. These areas have 50% of the population, but only 1½% of the space. So about 50% of our wastes are pouring out in this relatively small area. This, I think, accounts for our principal problem.

Still another viewpoint is frequency and duration. There are the acute pollution episodes such as Glasgow in 1901 and 1925; the Meuse Valley in Belgium in 1930; London in 1952 and 1956; and Donora, Pa., in 1948. The physiological effects of such episodes are easy to see. Opposed to that, you have the long-range type of exposure which may take years to develop chronic effects.

There is also an intermediate sort of pollution which might be called the pure eye irritation type—such as they have in Los Angeles. This might be considered on the borderline between health and nuisance. There are, in general, no chronic effects from eye irritation. I think that long-range exposure, even to low concentrations, is the thing with which public health people are most concerned.

For example, we know that the frequency of lung cancer is about twice as great in urban as in rural areas. There is also a higher frequency for stomach and esophagus cancer. What the relative importance of cigarette smoking and air pollution may be in causing lung cancer, nobody can say, but it seems certain that both play a part. Also, it seems quite probable that inhaled pollutants find their way into the esophagus and stomach via solution or suspension in body fluids which are swallowed. As evidence, we know that during the acute episodes some people suffered severe gastro-intestinal disturbances, showing there must have been ingestion of air-borne pollutants.

Chronic bronchitis is another big area that is being studied, particularly in England where it is some 37 times more prevalent than in the United States. It seems pretty well established that the high sulfur content of air over many British cities has an important effect.

There's still another aspect to the public health problem which, for want of a better term, I'll call mental health. I've repeatedly seen people made violently ill by the power of suggestion that there may be a poisonous compound present in a malodorous substance. And cases of economic loss are related to this kind of mental health—for example, the farmer who worries himself sick over a bad case of crop damage from air pollution. You can't blame people for worrying if nylon stockings dissolve on their legs. So even in cases where there may be no actual systemic effect, there can be mental effects that can't be divorced from health.

And then, there are what we might call the esthetic aspects. Take food. We have come quite a way in insisting on certain standards for our milk, our food, our drugs and our water. We won't even tolerate certain contaminants which are not in themselves harmful but are offensive from an esthetic, taste or odor standpoint.

So, I think that we shall move in the same direction with respect to air; we come into continuous contact with it, and to a greater extent than we do with either food or water. I believe complacency is on the wane and that soon we shall all be insisting on better air.

WILLIAM L. WILSON:
State Wants Enforcement To Be Primarily Local*

FOR MANY years it has been an important part of the philosophy of public health people that enforcement activities should be primarily local. That is true here as elsewhere. Our feeling at the state governmental level is that local agencies should go on with their own programs and that the state should come into it only when invited in to render assistance, or when there is a complete breakdown at the local level.

* Mr. Wukasch delivered Dr. Wilson's talk.—Ed.

In other words, we at the state level have no ideas of ever building a vast empire of control or of statewide inspection in any phase of public health. But we do think the state should have certain functions which I'd like to outline to you. There are some seven of these.

I think the first state function is one of survey. A central agency is needed for this function since it must not only keep abreast of what is going on in each locality, but it must keep informed of new problems, of new industries coming in, of population trends and of the way people in various areas feel about their local problems. This requires periodic checks and it also calls for correlation with other aspects of the over-all public health problem, for example, the relationship between vital statistics and the existence of air pollution.

As an example of this last point consider the London episode previously mentioned. It was only through the correlation made by the vital statisticians that it was discovered that 4,000 more fatalities than could normally have been expected occurred during this fumigation.

Another type of case where a central agency can develop significant relationships is in the situation where air pollution control may affect water pollution control, or vice versa. Frequently, control of one creates a control problem in the other; or one is used to support—or in lieu of—the other.

A second big area for state administration is in instrumentation. The state has many more instruments for pollution measurement and study than any local agency can have—and it lends them out. Many local agencies and industries are delighted to find they can borrow our equipment rather than having to invest in something that may mean only a one-time use. So we feel we are serving the citizenry in a very economical way in providing a "lending library" of instruments to cover most problems that must be evaluated. In some cases we can even send along engineers to go with the instruments.

A third big area for state activity is in training. We have trained personnel for both county and city health departments. This we do by bringing them to the Capital for in-service training with our own personnel; or by sending our personnel for short periods to work with the local man in his own area. This generally involves training in evaluation and sometimes in instrumentation, too.

Another sort of training carried out by our training division is what we call a road-show assignment. One of our men at present is making a swing among the industrial cities where he puts on a short seminar-type air-pollution training program. And still another aspect of training is our sponsorship of both governmental and industrial people at the Robert A. Taft Sanitary Engineering Center in Cincinnati which, as you know, is operated by the U. S. Public Health Service.

Something closely related to training is education and consultation. Our staff is constantly being called on for articles for local publication; for legal and technical opinions on local ordinances; for information on analysis techniques; for opinions on the efficacy of proposed pollution control methods and equipment. We often help in setting up local technical committees and some of us have ex-officio membership on these committees, to keep them abreast of what is going on elsewhere.

Another function of the state, I believe, is to assist in the establishment of state standards in those cases where an over-all state viewpoint is needed. The situation here is comparable to the establishment of state maximum speed laws which, however, may be reduced under suitable circumstances at the local level.

The sixth big area I see for state administration lies in compilation, correlation and distribution of state-wide data. Most local health departments now provide us with monthly or quarterly reports and keep us informed of their problems and progress so we can act as a clearing house to pass this information along for the benefit of the entire state. I think we can and should be doing more of this sort of thing.

The last area for state activity, I believe, lies in long-range study. There is a lot known about air pollution, but much more is still to be learned. For example, we know something about in-plant exposures based on say a 40-hr. week and a healthy adult male. But in air pollution we have all kinds of people exposed 24 hr. a day and 7 days a week. So what we know about toxicology under plant conditions needs a different approach when we're talking air pollution.

Then, there's the long-range study of synergistic effects that take place between substances which individually may be harmless. And the question of the physical state of the pollutants where particle size may be the factor which determines what is dangerous and what is not. We need to know more about meteorology, particularly its global aspects, and what happens to automotive exhaust and to industrial organics turned loose in the presence of ultraviolet light in the atmosphere.

I'm sure you would all like to have me tell you what is ahead in the way of state legislation on air pollution—but this I cannot do. Our department has been studying all available legislation and submitting our ideas to public hearing but we are still in the working stages and as yet no legislation has been introduced. Whatever we finally offer, the legislature may accept, modify or reject—but, at least, we shall feel we have done our best as public health servants to the rest of you.

Mrs. Maddox: I wonder whether we need more legislation in our state to take care of air pollution; and if we had it, might it not interfere with our local agencies in their own programs for pollution control?

Mr. Wukasch: State legislation should actually strengthen the hands of local authorities, especially in those gray areas where authority at present is not clearly spelled out.

Moderator: We are at the end of our scheduled time and as we close I'd like to call your attention to just one more matter, the five selected references which appear below. They are necessary additions to the library of every engineer interested in this field.

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2. "A Digest of State Air Pollution Laws," U. S. Public Health Service Division of Sanitary Engineering Services.
3. "A List of Air Pollution Publications," U. S. Public Health Service.
4. "Air Pollution Abatement Manual," $6. Manufacturing Chemists' Assn., Inc., Washington, D. C. (1952).
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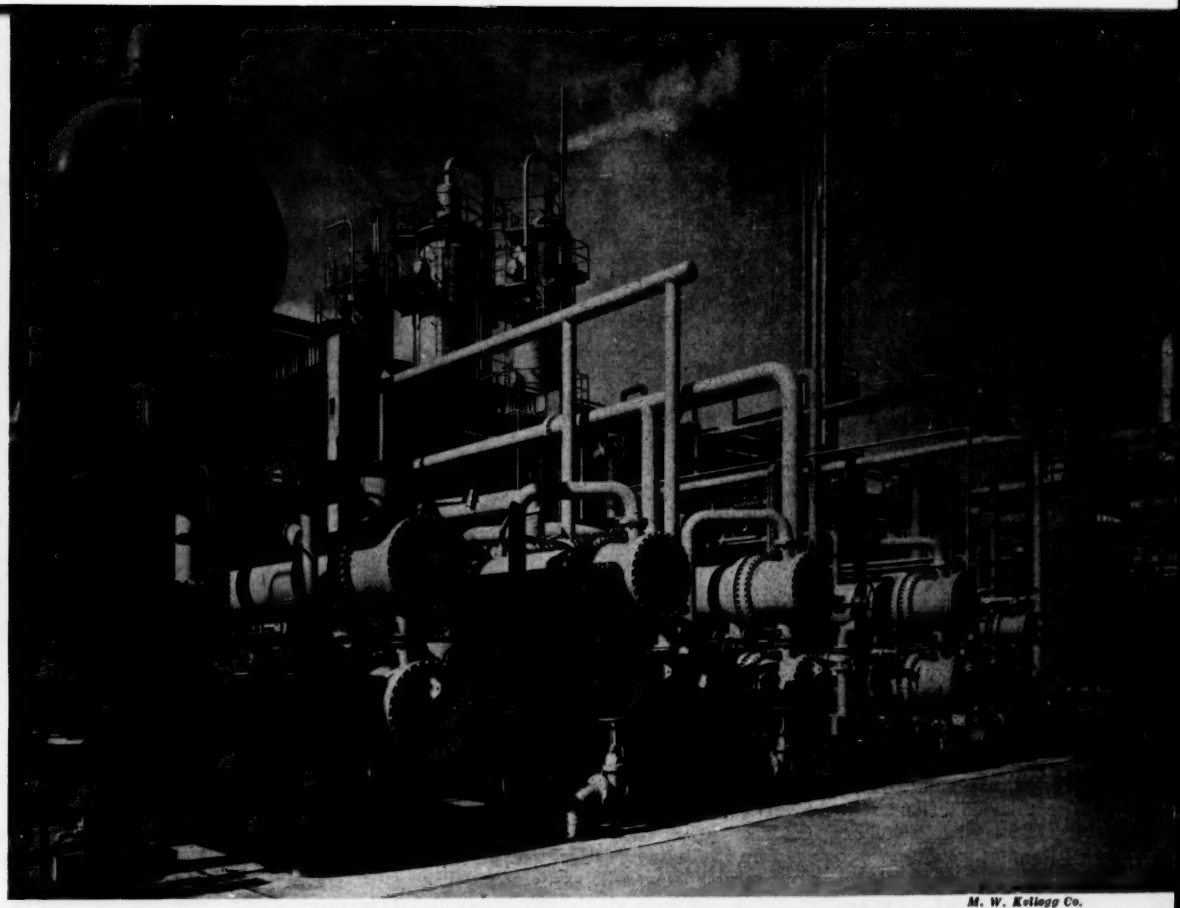


M. W. Kellogg Co.

Remedy for Equipment Fouling: High, Constant Water Velocity

Don't throttle cold winter-water flow—this invites fouling. Keep high velocities year round by recirculating heated water.

D. Q. KERN, D.Q. Kern Associates, Cleveland, Ohio
R. E. SEATON, Wolverine Tube, Div. Calumet & Hecla, Inc., Allen Park, Mich.

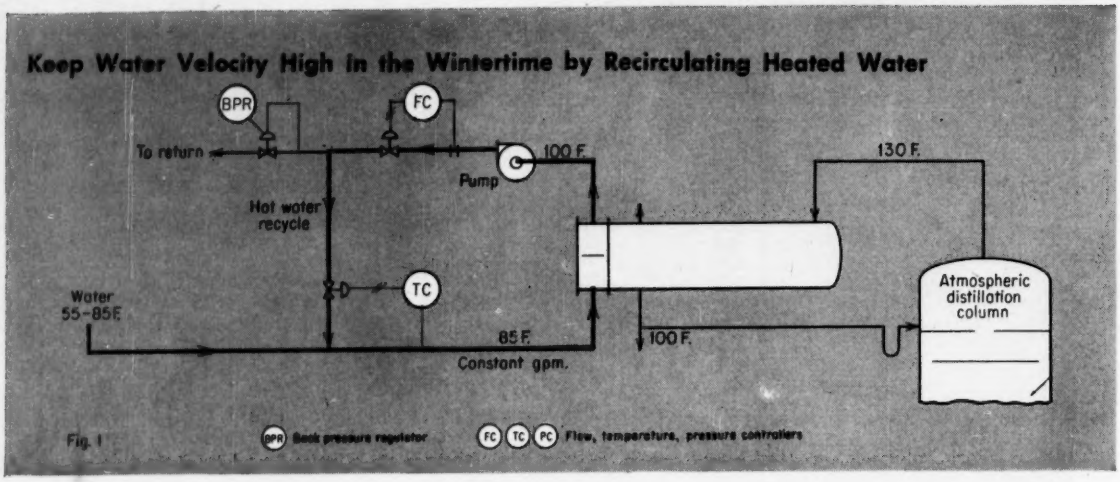
IN THE May 4 issue of *Chemical Engineering*, p. 145, an article appeared under the title, "Better (Not Less) Water Cooling," by an author selecting the anonym *Name Withheld*. He calls attention to the recent emphasis in the literature on air-fin coolers and indicates that it may be a fad.

He also suggests that this might be an excellent time to re-examine water-cooling procedures and to supersede outmoded methods with newer techniques. We heartily agree.

We believe he makes an even better point when he stresses that some common plant practices are not necessarily founded upon sound engineering principles. In support of his contention that the finest hour for water-cooling still lies ahead, he cites a paper which we presented at the annual meeting of the AIChE in Cincinnati last December, "A Theoretical Analysis of Thermal Surface Fouling."

In this paper,* an attempt was made to analyze surface fouling predicated on classical fluid dynam-

* Kern, D. Q. and R. E. Seaton, *Chem. Eng. Prog.* 55, 71, June 1959. (abridged); *Brit. Chem. Eng.* 4, 258, June 1959 (unabridged). See also Pet. Ref. 37, 140, 1958.



ics and mathematical manipulation. The final equations suggested that the service period of heat-transfer equipment could be prolonged indefinitely through advantageous use of fluid shear. Parallel analyses were also suggested which cover distilling columns, absorbers, reactors and piping.

We might mention that the paper was included in the AIChE "Symposium on Air-Cooled Heat Exchange" since a new mathematical approach to surface fouling was essential to development of a competent air-fin cooler design procedure. The fluid dynamics employed in our paper are applicable, with modifications, to any flowing stream and in particular to those providing heat-transfer surface.

Towards Non-Fouling

It is encouraging to note that the author of "Better (Not Less) Water Cooling" has recognized the implications of the theoretical analysis of surface fouling and, in the pages of *Chemical Engineering*, is the first author to refer to it in print. However, as pointed out in our paper, consideration must be given to several important aspects of plant design, such as product purity and climatic conditions, before a non-fouling plant can be achieved.

For instance, thermal process units (coolers and condensers) designed for summertime conditions can run into trouble in the winter. The colder cooling water has to be throttled down, decreasing velocities, and increasing the chance for fouling.

Nevertheless, we know that most process plants are designed for the limiting conditions of summer or winter cooling-water conditions, however briefly such conditions exist. But techniques are available for avoiding these climatic difficulties. Such designs prolong plant operations and even reduce plant turnaround expenses.

In the power industry it is customary to compute plant efficiency based upon an annually integrated value of the cooling water passing through the surface condenser. This means that the plant with a fluctuating water temperature can operate more efficiently in the wintertime when the surface condenser rejection temperature is lower, than it can in the summertime, although some throttling would be required. In the past, substantially more power was generated in the wintertime than in the summertime and the acceptance of this convention was suggested by convenient economics. In recent years growth of air conditioning in many areas has tended to reduce this difference between summer and winter loads.

But efficiency is only a dimensionless fraction. In the process industries there is often a product purity which must be maintained stringently through summer and winter climates.

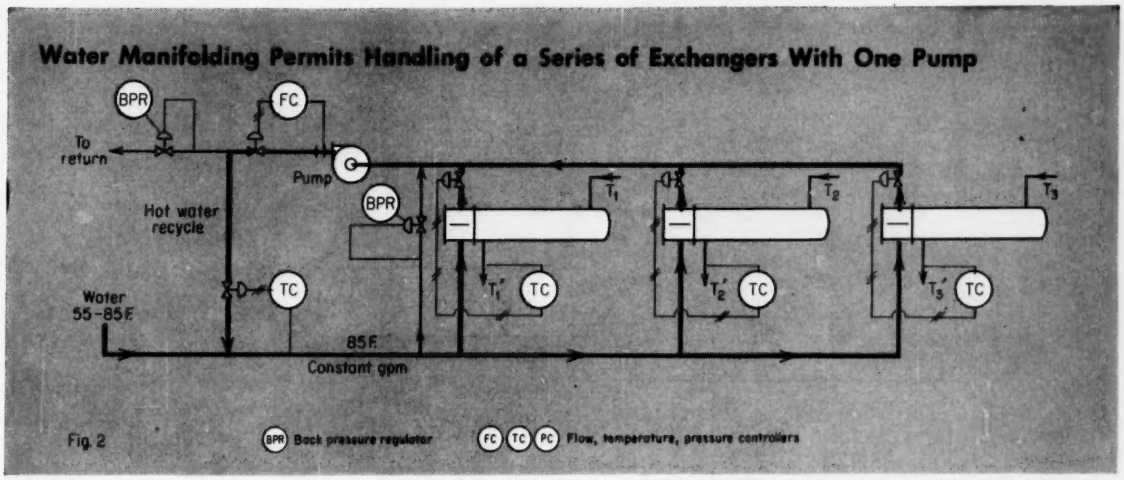
Winter-Summer Design

Confining ourselves to distillation plants, the case was cited in our paper in which components were separated from feed and overhead product condensed over the range 130 to 100 F.

Cooling water will have a variable temperature with changing seasons. If the condensation from 130 to 100 F. occurs in a 1-2 condenser, the cooling water range might be set at 85 to 100 F. To be consistent with a variety of design specifications we can assume a water linear velocity of 3 fps. during the summertime operation.

For wintertime, consider an exaggerated, rapid water temperature decline to 55 F. If the approach temperature is considered roughly constant, when the water decline occurs condensate temperature will fall to 70 F. in the absence of a water-flow correction. The utility demand on the reboiler will suddenly increase while overhead product purity will deteriorate. This deterioration results when subcooled reflux nullifies the effectiveness of some of the upper trays.

Where the flow rate of the cooling water is not used for pressure control, the usual correction would be to throttle the water flow so the coolant operates over the range from 55 to 100 F. while the condensate temperature is nudged back to 100 F. Unfortunately, this type of correction reduces the water



velocity to only 1 fps. and surface fouling is greatly amplified inside the tubes, according to our derivations.

This fluctuation can be eliminated by designing the plant to operate economically with nearly constant annual water velocity and temperature. Such a procedure could be accomplished by the simplified arrangement shown in Fig. 1. Here, heated water recirculates with seasonally colder water coming from the cold-water supply main. Differential water pressure controllers and more complex control elements can also be used advantageously.

From our experience, the plant designer will at first reject this suggestion because it implies use of an additional pump at each cooler or condenser. This is not so. Wherever there is a water supply and a return main a single pump serves all coolers and condensers. Adjustments for all are made at one point. Such an arrangement is shown schematically in Fig. 2 and many variations are possible. The figure also points up some improvements which can be made in water manifolding.

Controlling Pressure

In distillation plants which do not operate at atmospheric pressure, flow of condenser cooling water is often used for pressure control, a point which also deserves consideration. It is desirable that control-water temperature undergoes only minor seasonal fluctuation. Usually the control valve is sized for summer operating conditions. However, when winter water is very cold a problem of throttling is created when using a simple automatic controller. Since the water-control valve is obliged to operate at its narrow opening for pressure control, the operating pressure of the system may tend to fluctuate considerably.

On occasion this pressure variation has been blamed on the seasonal fluctuation of the ambient air velocity and temperature at the plant. Computation generally indicates that the loss of heat from an insulated thermal process plant due to varying ambient conditions is usually very small. The reason for the fluctuating pressure is probably a simple one: a large control valve is expected to perform the services of a needle valve on a trickle of cold water.

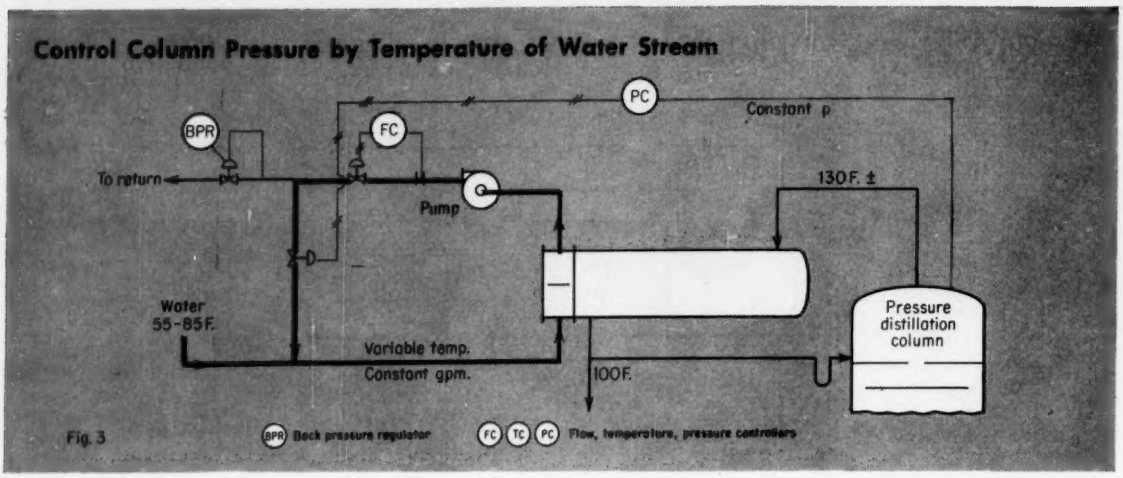
In every chemical plant some effort is made to monitor the temperature of the cooling water (cutting out cooling towers in cold weather). This is not always possible. Surface and subsurface waters must frequently be taken just as they come from their sources. In fact, we often observe process units running for weeks or months with throttled water considerably below the temperature and velocity for which the apparatus was designed.

Design Scheme

There is no objection to the use of cooling water for pressure control. Fig. 3 shows how it can be done readily while maintaining the high water velocity desirable for suppression of fouling. In this arrangement the cold temperature of the fluctuating water supply itself would be used as the correcting agent through the use of a flow controller and a throttling valve operating off the responses of a pressure controller on the recirculating line. In this way pressure control would be effected by changing the temperature of a flow-controlled water stream.

It is true that a fluctuating water temperature cooling line is still employed as in the conventional case. But one advantage has been achieved: the water is maintained at a velocity high enough to continuously produce sufficient shear to keep its flow path and heat-transfer surface clean.

Incorporation of this characteristic into the design of a plant costs no more than the conventional plant when all factors are taken into account. It is true that a pump, a flow controller, and some extra piping must be added to the system. These are minor items, however, for a plant facility whose operating period may be extended by hundreds of hours. Conceivably, smaller heat transfer equipment would be required, too. In the long run, and



even the short run, use of these recommendations would eliminate a number of the complex uncertainties with which the modern chemical plant tries to cope.

For the average light ends petroleum plant it is not inconceivable that the period of uninterrupted operation could span the time from initial startup to process obsolescence. Roughly, this is perhaps from seven to ten years. In a plant having dirtier services it might prove economically advantageous to reduce this period to three or four years.

D. Q. Kern

R. E. Seaton

DONALD Q. KERN has had training at M.I.T. and Brooklyn Polytechnic. He heads D. Q. Kern Associates, a thermal design and application organization. From 1943 to 1953 he was a professor of chemical engineering at Brooklyn Polytechnic, specializing in advanced instruction in heat transfer and thermodynamics. Dr. Kern is the author of the popular text "Process Heat Transfer" (McGraw-Hill).

RALPH E. SEATON is technical sales supervisor for Wolverine Tube. He is a graduate of the University of Detroit (ME), with a varied background in heat transfer work. Mr. Seaton is in charge of technical product sales to the processing, power and nuclear energy industries.

Sewage No Panacea

Also recommended by the unidentified author is use of reclaimed sewage water as a cooling medium.

His term reclaimed sewage water is introduced without qualification and in our own experience it seldom qualifies as an economical water supply—except where it is the only water supply. There are plants in some localities which even employ raw sewage for peak summer loads. In such instances the sewage is usually withdrawn at an intermediate point between a residential or industrial area and the nearest available sewage-treatment facility. Depending upon the extent of sewage reclamation, a cooling medium can be produced with a varying range of purity and, unfortunately, at a proportionate cost.

Rendering sewage bacterially inactive is perhaps the smallest of the problems. To reduce surface fouling it is usually also necessary to provide settling, clarification and filtration which may prove to be costly operations. In addition, there is the hazard that quantities of incompletely reclaimed sewage may enter a part of the plant central water system, be recirculated, and contaminate the major supply facilities.

With regard to *Name Withheld,* we commend his initiative in connecting the sewer to every cooler and condenser and relying upon our theory as his bulwark. We wish to point out that his cooling medium might subject our theory to undue strain—for this is not ordinary fouling he proposes.

Low-Cost Tubes

The author also discusses high-level natural convection air-cooling with low-cost finned surfaces and a fluid-outlet-to-air-approach temperature of 70 to 100 F.

We believe he intended this as a point in passing rather than an analytical conclusion. But he raises an interesting idea relative to cheap fin surfaces. Many purchasers evaluate air-fin cooler proposals on the basis of the gross internal surface of the finned tubes and few use the gross external finned surface. Here is where the cost of the tube does make a difference. The quantity of fin metal and base tube which is offered can only be as effective as the quality of the tube. This is the critical point no matter what surface is used for reference. Higher cost tubes prove their worth by providing a close approach when needed most—in the summertime.

Free—For your files—Check your Reader Service postcard (p. 209) for an extra copy of this article.

Experimental Data for Thermal Conductivity of Fused Salts

Mixture	Composition[a]	$(k_T)_m$[b]	$M_{avg.}$	$N_{avg.}$	T_m, Deg. K.	ρ_m, Gram/Cc.	$(k_A)_m$[f]	$(A\%)_m$	Ref.
A	LiF–RbF (43–57)	1.2	70.75	2	748	2.844	0.312	26.0	4
B	RbF–ZrF_4–UF_4 (48–48–4)	1.0	143.08	3.56	698	3.604	0.1026	10.3	4
C	NaF–ZrF_4–UF_4 (53.5–40–6.5)	1.2	109.75	3.40	813	3.446	0.1739	14.5	4
D	NaF–BeF_2 (57–43)	2.4	44.15	2.43	633	2.137	0.529	22.0	4
E	NaF–ZrF_4–UF_4 (50–46–4)	1.3	110.48	3.50	793	3.446	0.1644	12.7	4
F	NaF–KF–LiF–UF_4 (10.9–43.5–44.5–1.1)	2.3	44.84	2.03	725	2.243	0.569	24.8	4
G	NaF–KF–LiF (11.5–42–46.5)	2.6	41.30	2	727	2.199	0.651	25.1	4
HTS	KNO_3–$NaNO_2$–$NaNO_3$	0.33	84.40	2	415.4	1.982	0.1267	38.4	4
	(44.15–48.90–6.95)	0.617[c]	84.40	2	415.4	1.982	0.1267	20.5	5
NaOH	97.6 wt. % NaOH	0.480[d]	40.01	2	591.6	1.785	0.527	110.0	6
		0.533[e]	40.01	2	591.6	1.785	0.527	99.5	6

NOTES—*a.* Numbers in parentheses indicate mole percent of corresponding components; *b.* Total thermal conductivity at T_m, in Btu./ (hr.) (ft.) (°F.). Values are experimental with an estimated accuracy of ± 25% ; *c.* Value calculated by Colburn heat transfer coefficient equation from heat transfer data of Ref. 5; *d.* From smoothed curve; *e.* Maximum from plot of experimental values; *f.* From Eq. (3).

Fused Salt Thermal Conductivity

Difficult to determine experimentally. Rarely found in print. Here's a prediction method that's just been declassified.

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TO PREDICT heat transfer rates in molten-salt, circulating-fuel nuclear reactor systems, one must first have thermal conductivity data. This article, based on an earlier Oak Ridge National Laboratory (ORNL) memo,[1] outlines the development of a generalized estimation method for such data.

Thermal conductivity data for fused salts are difficult to determine experimentally; and only very rarely will you encounter these data in the literature.

First, we must recognize that the total conductive heat transmission in fused salts is composed of two distinct portions:

- The atomic or lattice contribution, arising from the short-range atomic or molecular order present in liquids generally.
- The ionic contribution, arising from a drift of free charged ions, and subsequent energy transfer, between the atoms.

Therefore, the case of fused salts is intermediate between the cases of (a), pure organic liquids, which are nonelectrolytes with conductivities due solely to the atomic or molecular contribution; and (b), liquid metals, where the electron drift (corresponding to the ionic contribution for fused salts) is almost entirely dominant. Thus, with fused salts, we must account for each of these mechanisms.

Of the five correlation procedures we have tried, only the one detailed here proved to be of value.

Rao's semitheoretical equation:[2]

$$k = 1.21 T_m^{1/2} \rho_m^{2/3} / M^{7/6} \qquad (1)$$

and that of Osida:[3]

$$k = 0.75 T_m^{1/2} \rho_m^{2/3} / M^{7/6} \qquad (2)$$

which differ only in the magnitude of the constant, supposedly give the thermal conductivity of the newly formed liquid phase of nonelectrolyte liquids at their normal melting points.

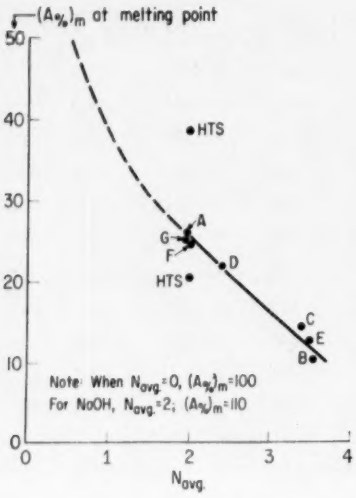
Our approach consists of calculating the atomic portion of the total thermal conductivity from Eqs. (1) or (2), dividing this value of $(k_A)_m$ by the experimental value of $(k_T)_m$ to obtain $A\%$. Data and calculations are given in the table above.) Next, we attempt a correlation of $A\%$ with a variable which measures ionic contribution.

Using this method Eqs. (1) and (2) did not yield a good correlation, though the trend of the results held promise. Satisfactory correlation was obtained when we modified Eq. (1) empirically to:

$$(k_A)_m = 10.43 T_m^{1/2} \rho_m^{4/5} / M^{9/5} \qquad (3)$$

For the salt mixtures listed in the table, T_m was taken as the liq-

Ionic Contribution Plot



uidus temperature, and $M_{avg.}$ was obtained from:

$$M_{avg.} = \sum_i x_i M_i \qquad (4)$$

The remainder of the total conductivity—the ionic contribution—correlates best, on the basis of available auxiliary data, by a simple plot of $A_{\%}$ vs. $N_{avg.}$, where:

$$N_{avg.} = \sum_i x_i N_i \qquad (5)$$

in which $N_{avg.}$ might be designated as the "average ion number." We show this plot above. The linear portion of the curve, for $2.0 < N_{avg.} < 3.6$, may be represented by:

$$A_{\%} = 43.8 - 9.0N_{avg.} \qquad (6)$$

Data for fused-salt mixtures *A* through *G* fit the curve with good precision. At an abscissa value of zero, indicating nonelectrolyte, $A_{\%}$ is 100, as ions are no longer present. The extreme deviation of NaOH is probably because of hydrogen bonding of its hydroxyl radicals, which effectively reduces the ionic mobility to the extent that essentially all of the conductivity is of the lattice type.

The two values plotted for "heat transfer salt" (HTS) show poor agreement with one another, but the arithmetic average deviates from the curve by only 14%.

Our procedure, then, for estimating the total thermal conductivity of a fused salt at its melting point, or of a fused-salt mixture at its liquidus temperature, is:

- Calculate $(k_A)_m$ from Eq. 3; and $N_{avg.}$ with Eq. (5).
- Use the ionic contribution plot or Eq. (6) to obtain $A_{\%}$.
- Divide $(k_A)_m$ by $(A_{\%}/100)$ to obtain $(k_T)_m$.

It's apparent that the final correlation is heavily dependent on data for fused-fluoride-salt mixtures, but no other experimental data—other than HTS and NaOH—are known to the writer.

Temperature Dependence

Wilson[7] has correlated the electronic contribution to the thermal conductivity of liquid metals by:

$$k_e = \frac{\pi^2}{3} \times \frac{n\tau k_B^2 T}{m} \qquad (7)$$

where n is the number of free electrons/unit volume; τ = avg. time between electronic collisions; k_B is Boltzmann's constant; and m is the mass of an electron.

Assuming correspondence of the electronic contribution in liquid metals and of the ionic contribution in molten salts, and by applying standard kinetic theory to the ion behavior, we can obtain the following from Eq. (7):

$$k_I \propto \rho T^{1/2} \qquad (8)$$

where k_I is the ionic contribution to thermal conductivity for fused salts.

Temperature dependence of the atomic contribution may be obtained from any of several fairly accurate relations for organic liquids, whose conductivities are 100% atomic. The following relation, derived from the work of Sakiadis & Coates, was chosen as possibly the most satisfactory:[8]

$$k_A \propto c_p \rho^{5/3} \qquad (9)$$

Combination of Eqs. (8) and (9) gives the final postulated temperature function:

$$\left(\frac{k_{T2}}{k_{T1}}\right) = (F.A.)_1 \left(\frac{\rho_2}{\rho_1}\right)^{5/3} \left(\frac{c_{p2}}{c_{p1}}\right) + (F.I.)_1 \left(\frac{\rho_2}{\rho_1}\right) \left(\frac{T_2}{T_1}\right)^{1/2} \qquad (10)$$

where (*F. A.*) denotes "fraction atomic" = $A_{\%}/100$; and (*F. I.*) denotes "fraction ionic" = $1 - (A_{\%}/100)$.

Using Eq. (10) the following values were calculated for salt mixture *E*: k_m = 1.3; k at 900 C. = 1.36; % change = +4.7. And for salt mixture *C*: k_m = 1.2; k at 900 C. = 1.28; % change = +6.4.

We can see that if the derived relation is valid, the thermal conductivities of the pertinent fused salts are relatively temperature-independent, increasing only slightly with temperature. Unfortunately, no reliable high-temperature data are available for checking Eq. (10).

Problem—Calculate the thermal conductivity of molten NaCl at its melting point.

Solution — Temperature at the melting point is 1,073.6 K.; ρ_m = 1.545 grams/cc. The molecular weight, M = 58.45 grams/gram-mole; and the number of ions per dissociated molecule (from the chemical formula), N = 2.0.
From Eq. (3),

$$(k_A)_m = 0.3205 \text{ Btu./(hr.)(ft.)(°F.)}$$

From Eq. (6),

$$A_{\%} = 25.8$$

Therefore,

$$(k_T)_m = 0.3205/0.258 = 1.242 \text{ Btu./(hr.)(ft.)(°F.)}$$

Nomenclature

$A_{\%}$	Percent atomic contribution to total thermal conductivity at the melting point.
c_p	Liquid heat capacity at constant pressure.
k	Thermal conductivity, Btu./(hr.) (ft.) (°F.).
M	Molecular weight.
$M_{avg.}$	Avg. molecular weight of a mixture.
N	Number of ions per dissociated molecule (from the chemical formula).
$N_{avg.}$	Above for a mixture.
T	Absolute temperature, deg. K.
x	Mole fraction.
ρ	Liquid density, grams/cc.

Subscripts

A	Atomic.
i	Ionic.
m	At the melting point.
T	Total.
1	At the lower temperature, T_1.
2	At the higher temperature, T_2.

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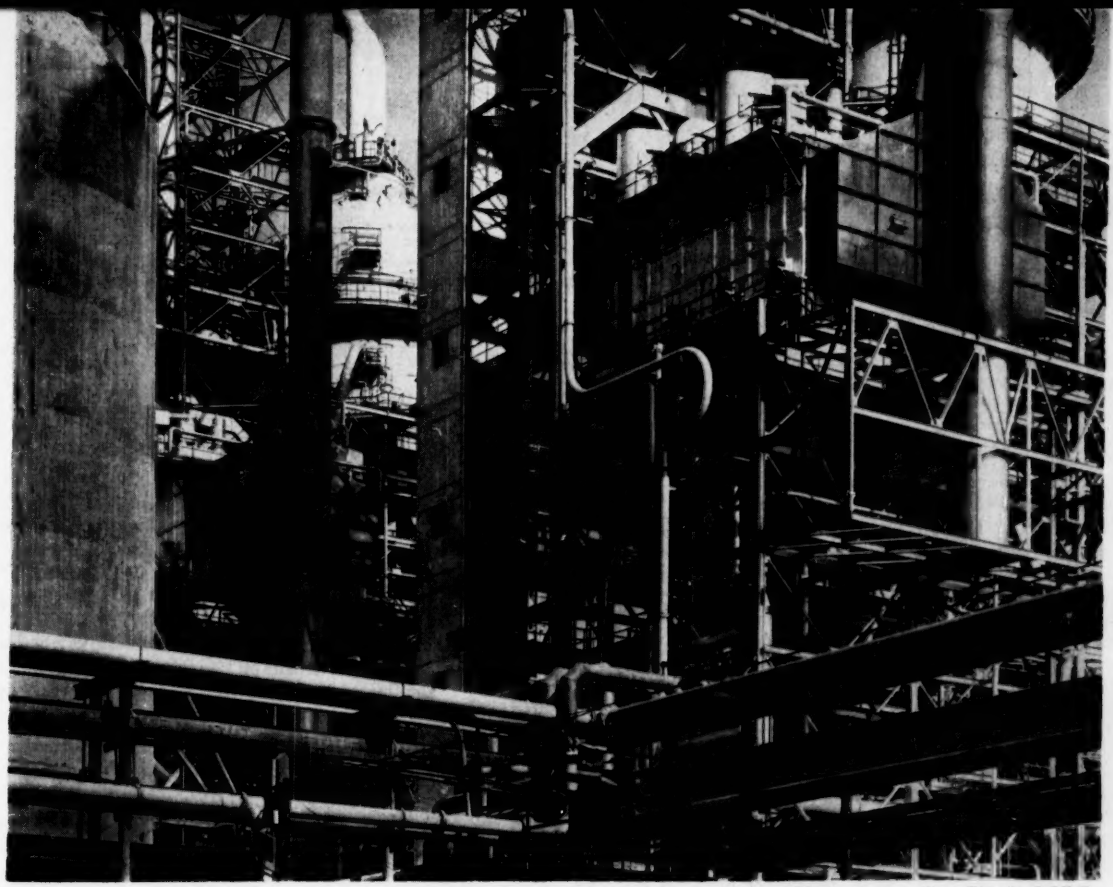


Photo courtesy Esso Standard Oil Co.

CE Refresher

How to Handle Unusual Flow

Special methods of analysis are necessary to relate energy requirements, rate of flow and conduit dimensions for compressible fluid flow and flow in complex piping.

JESSE COATES and BERNARD S. PRESSBURG, Louisiana State University, Baton Rouge, La.*

FLOW of compressible fluids and flow in complex piping and piping networks require methods of analysis which differ from liquid flow in circular conduits. For noncircular conduits, we may use the same relations as for circular conduits providing we define an equivalent diameter.

In piping networks consisting of the same or different pipe sizes connected in series or parallel or both, we must derive methods for calculating total resistance to flow. Pressure changes occurring in compressible fluid flow affect the physical properties of gases and vapors and consequently their flow behavior. In this installment, we'll discuss these differences and show how to calculate flow relations for these systems.

For circular pipes, flow rate is given by:

$$W = \frac{F}{R} = \frac{F}{\frac{4 f w L}{2 g_c (\pi/4)^2 D^5 \rho^2}} \quad (1)$$

In Eq. (1), f is an empirical constant that depends on the nature of the flow. Relative velocity and direction of flow of fluid particles at various positions in the pipe determine the nature of this flow. It is conveniently correlated by the Reynolds number:

$$N_{Re} = Dv\,\rho/\mu = 4w/\pi D\mu \quad (2)$$

When other shapes of conduits are considered such as straight-sided ducts, annular sections and pipes not

*To meet your authors, see *Chem. Eng.*, May 18, 1959, p. 182.

full, there is no obvious dimension to use in these equations in place of the diameter of the circular pipe.

However, recognizing that the basic resistance mechanism is shear, we can put circular sections on comparable basis so that the same friction factors may be utilized.

$$\tau = \frac{\text{Force}}{\text{Shear Area}} = \frac{\Delta P \times S}{\text{Shear Area}} = \frac{\mu dv}{g_c dr} \quad (3)$$

$$\tau_o = \frac{\mu}{g_c}\left(\frac{dv}{dr}\right)_o \quad (4)$$

In Eq. (4), the subscript o denotes consideration at the wall where the flow is exclusively laminar. The pipe dimensions enter as the ratio of transverse area S to shear area. For circular pipes, this ratio is $(\pi D^2/4)/(\pi DL)$ which reduces to $D/4L$. For other shapes, we can define an equivalent diameter such that $D_{Eq}/4L$ is equal to the ratio of flow area to shear area. Since the shear area is the perimeter of the section in contact with the fluid multiplied by its length:

$$D_{Eq} = 4 \text{ (flow area/wetted perimeter)} \quad (5)$$

In practice, use of this equivalent diameter in place of D in the Reynolds number and in Fanning's equation gives a satisfactory approximation if these equations are written in terms of velocity as shown in Problem 1. The term $v(\pi D_{Eq}^2/4)$ is not the volumetric rate of flow, as it is for circular pipes, and the resistance cannot be as readily expressed in terms of w.

Problem 1—Evaluate the pressure drop caused by friction as water at 70 F. flows through an 8-ft. annulus between an 1-in. and a 2-in. standard steel pipe at a velocity of 5 fps. Pipe roughness is 0.00015 ft. and viscosity of water is 0.979 centipoise.

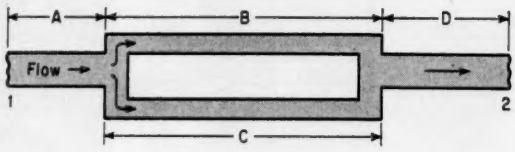
$$D_{Eq} = 4\left[\frac{(\pi/4)\,(2.067^2 - 1.315^2)}{\pi\,(2.067 + 1.315)}\right] = 0.752 \text{ in.}$$

$$N_{Re} = Dv\rho/\mu = 297{,}000$$

Nomenclature

D	Pipe diameter, ft.
D_{Eq}	Equivalent diameter for noncircular conduits, ft.
e	Base of natural logarithms, 2.718.
f	Fanning friction factor, dimensionless.
F	Potential to overcome fluid friction, ft.
g_c	Gravitational conversion factor, 32.2 ft./sec.^{2}
G	Mass flow rate, lb./(sec.) (ft.^{2}).
k	Ratio of specific heats, dimensionless.
K	Empirical constant for Eq. (8).
L	Pipe length, ft.
L_{Eq}	Equivalent length of pipe including fittings, equipment and valves, ft.
M	Molecular weight, lb.-mole.
N	Dimensionless group $= 4fL_{Eq}/D$.
P	Pressure, psi.
R	Flow resistance.
r	Pipe radius, ft.
S	Transverse area of conduit, sq. ft.
T	Absolute temperature, deg. R.
v	Linear velocity, fps.
V	Fluid volume, cu. ft./lb.
w	Flow rate, lb./sec.
z	Compressibility factor for gases, PV/nRT.
ΔP_F	Pressure drop due to friction, psi.
μ	Fluid viscosity, lb./sec.-ft.
ρ	Fluid density, lb./cu. ft.
τ	Shear force/area, lb./sq. ft.

Find Total Flow Resistance



Since roughness ratio is $\epsilon/D_{Eq} = 0.0024$, friction factor for this Reynolds number is 0.0078 (*Chem. Eng.*, July 13, 1959, p. 151). For turbulent flow, use the Fanning equation and convert to dimensions of psi.

$$\Delta P_F = \frac{4fLv^2}{2g_c D_{Eq}} \times \frac{62.3}{144} = 0.67 \text{ psi.}$$

This form of the equivalent diameter should not be expected to hold if the shape of the conduit is such that its velocity pattern is radically different from that in circular pipes. Correction factors[1] and alternative expressions for many shapes are available.

Consider Flow in Piping Networks

In many cases, the piping system consists of several sizes and lengths of pipe, connected in series or in parallel, rather than a single pipeline. A cooling-water distribution system, feeding many different units, is a typical example.

By analogy to electrical systems, total resistance and the corresponding rate of flow through such piping networks may be expressed quantitatively. Resistances in series add directly while those in parallel add as reciprocals, exactly as required by Kirchoff's law for electrical networks. For example, in the piping diagram shown, all of the flow goes through pipes A and D which are in series, but the flow divides between B and C which are in parallel.

Thus, the total resistance between Points 1 and 2 is:

$$R_{Total} = R_A + R_D + \frac{1}{(1/R_B) + (1/R_C)} \quad (6)$$

Expressed in terms of hydraulic flow, resistance and potential:

$$W_A = W_D = W_B + W_C = \frac{F_{12}}{R_{Total}} \quad (7)$$

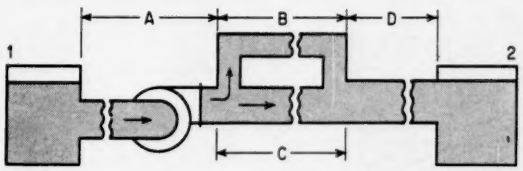
Flow resistance for each part of the network is calculated from the general equation:

$$R = \frac{4fwL}{2g_c(\pi/4)^2 D^5 \rho^2}$$

While the solution of Eq. (7) is more involved than it is for flow in a single pipe, this approach can be used to determine the potential required F_{12}, total flow w_A, or the flow distribution through the branches w_B and w_C, or the pipe sizes necessary for a specified flow and over-all potential. The principles and techniques are illustrated in Problem 2. We can apply this method to any number of pipes in parallel or in series, or any combination of these.

In piping networks, there is friction due to the

Find Flow in Branch Lines



accompanying turbulence whenever there is a change of cross section. For example, flow from a larger pipe enters a smaller pipe, or from a pipe to a storage vessel or conversely. The potential needed to overcome this resistance may be determined by either of two methods:

1. Express the resistance as an equivalent pipe length, just as is done for valves and fittings.
2. Use the relation,

$$F = Kv^2/2g_c \qquad (8)$$

In Eq. (8), K is an empirical constant whose value depends on the ratio of the two cross-sectional areas and v is the velocity in the smaller section. Values of K for expansions ($S_1/S_2 < 1$) and contractions ($S_1/S_2 > 1$) may be found in standard texts[2] and handbooks. Typical values are combined in a single plot and shown as Fig. 1.

In either method, the resistance caused by change in cross section may be considered to be in series with the resistance to flow in the pipe itself. Thus, in the first method the L_{Eq} of the change is added to the length of the pipe and fittings. In the second method, the F or ΔP_f due to expansion or contraction is added to the potential or pressure drop corresponding to the flow through the pipe and fittings.

Problem 2—Water at 80 F. flows through processing units located in branches B and C of the piping system shown in the sketch. The pump delivers 200 gpm. Equivalent length of pipe, fittings and process equipment is 100 ft. of 4-in. pipe for section A; 500 ft. of 1½-in. pipe for B; 200 ft. of 2½-in. pipe for C; and 500 ft. of 3-in. pipe for D. Pipe is schedule 40 steel. Points 1 and 2 are at the same elevation and are at atmospheric pressure.

What is the flow through branch B and branch C?

What horsepower must the pump supply to the fluid?

Consider lines B and C first.

$$w_B + w_C = 200 \text{ gpm. or } 27.8 \text{ lb./sec.}$$

Since lines B and C are parallel, $F_B = F_C$.

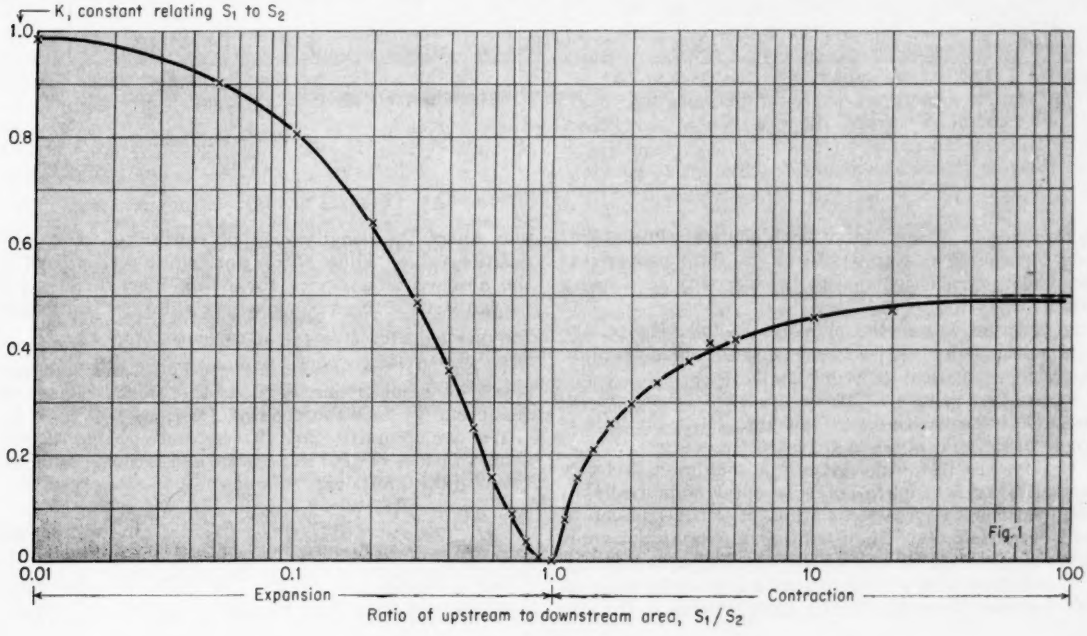
By expressing F_B and F_C in the terms of Eq. (1) and solving the above equations simultaneously, we get $F_B = F_C = 38.0$ ft.-lb./lb. when $w_B = 4.55$ lb./sec. and $w_C = 23.25$ lb./sec.

Since all of the flow goes through pipes A and D, the potential required for each may be calculated in the same manner as shown for the problem in *Chem. Eng.*, July 13, 1959, p. 151. Hence, $F_A = 2.92$ ft.-lb./lb. and $F_D = 56.6$ ft.-lb./lb. Therefore, required horsepower equals $97.5 \times 27.8/550 = 4.93$.

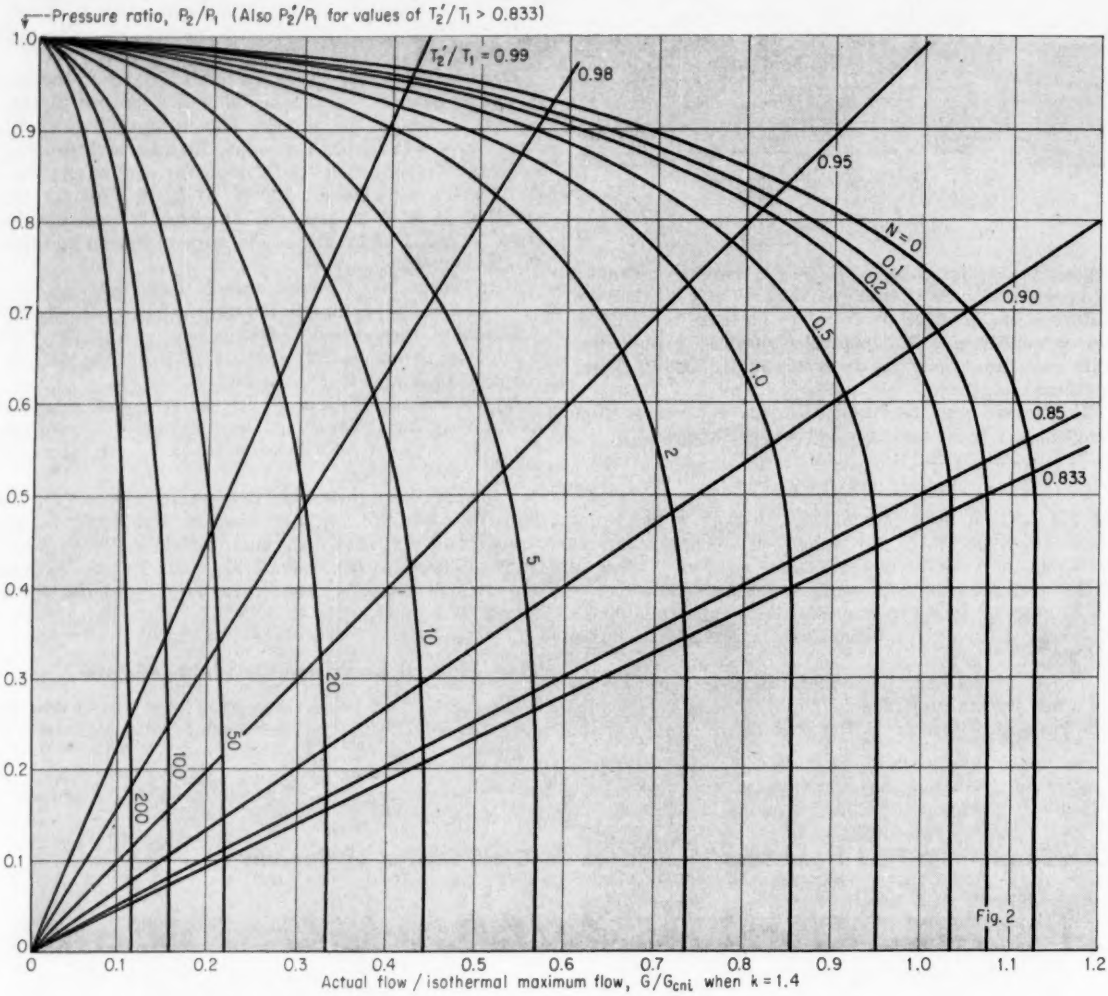
How Flow of Compressible Fluids Occurs

Application of these same principles to the flow of compressible fluids requires consideration of several

Use Constant to Find Head Loss for Change in Cross Section of Conduit



Lapple Chart Helps to Calculate Actual Flow and Downstream Pressure



factors which do not enter with liquids. These are:

1. Change in pressure affects the fluid properties: the density in particular and the viscosity to a lesser extent.

2. Friction causes the pressure to fall. Hence, the fluid expands and in so doing may be considered to perform mechanical work on itself.

3. Greater volume at lower pressure causes an increase in the average linear velocity. Thus, the fluid is accelerating and increasing its kinetic energy.

4. Compressible fluids attain a maximum velocity regardless of how much potential for flow is available. The first three effects occur simultaneously and can be considered together. The fourth may or may not apply in a specific instance and will be considered separately.

Usual treatment of this situation is to write the relation between these effects at a specific point in the system where the density may be considered to have a definite value. Thus, for a horizontal section and in the absence of a device for doing mechanical work, we can write a force balance over a differential length.

$$PdV = v\,dv/g_c + d(PV) + 4f\,dL\,w^2/2g_c\,D^5\,(\pi/4)^2\,\rho^2 \qquad (9)$$

In Eq. (9), the first term represents work of expansion, the second: acceleration, the third: change in static energy and the fourth: friction.

We can simplify Eq. (9) by noting that $d(PV)$ equals $PdV + VdP$. Hence, the integral equation between finite limits is:

$$-\int_{P_1}^{P_2} VdP = \int_{v_1}^{v_2} v dv/g_c + \int_0^L \frac{4fw^2}{2(\pi/4)^2\,g_c D^5 \rho^2}\,dL \qquad (10)$$

Since ρ equals $1/V = P/(1/M)zRT$, density varies continuously from inlet to outlet. For integration pur-

poses, density can be removed from the friction term by multiplying the equation by ρ^2 or dividing by V^2. If we do so and express v and dv in terms of w, Eq. (10) becomes:

$$-\int_{P_1}^{P_2} \frac{dP}{V} = \int_{P_1}^{P_2} \frac{w^2}{g_c\rho(\pi D^2/4)^2}\,dP + \int_0^L \frac{4fw^2\,dL}{2g_c(\pi/4)^2D^5} \qquad (11)$$

Integration of the first two terms depends on the constancy of the temperature. In the absence of heat transfer, the energy balance shows the only significant change in temperature to be that corresponding to the change in kinetic energy. Further calculations show that this would be only a few degrees for the typical case In most fluid flow situations, the fluid tends to cool and heat will flow into it. Thus, any decrease in temperature is offset by this inward flow of heat.

Accordingly, isothermal flow is the most probable situation and is assumed for the integration of Eq. (11).

$$\frac{P_1^2 - P_2^2}{2zRT/M} = \frac{w^2}{g_c(\pi D^2/4)^2} \ln\frac{P_2}{P_1} + \frac{4f_{avg}w^2L}{2g_c(\pi/4)^2D^5} \qquad (12)$$

Rearrangement of the term on the left shows that:

$$\frac{P_1^2 - P_2^2}{2zRT/M} = (P_1 - P_2)\,\frac{(P_1 + P_2)\,M}{2zRT} = (P_1 - P_2)\,\rho_{am}$$

where ρ_{am} is the density at the arithmetic mean pressure.

Substituting this expression into Eq. (12) and dividing by ρ_{am}^2 gives an energy balance comparable to Eq. (9) but differing in that it is on a finite rather than a differential basis.

$$\frac{P_1 - P_2}{\rho_{am}} = \frac{w^2}{g_c(\pi D^2/4)^2\rho_{am}^2} \ln\frac{P_1}{P_2} + \frac{4f_{avg}w^2L}{2g_c(\pi/4)^2D^5\rho_{am}^2} \qquad (13)$$

The term on the left corresponds to the $\int PdV$ which is the work of expansion including, as previously developed, ΔPV which is zero for isothermal flow. In effect, this term defines $V_{avg} = 1/\rho_{am}$ such that

$$-\int_{P_1}^{P_2} PdV = -V_{avg}\int_{P_1}^{P_2} dP = V_{avg}(P_1 - P_2) \qquad (14)$$

The first term on the right in Eq. (13) is the energy required for the increase in kinetic energy. It can be, and frequently is, rearranged in alternative forms using whatever units are most convenient for a specific application.

The last term on the right is the energy consumed in overcoming friction. Since the hydraulic resistance contains the density squared term in its denominator, the potential required to move a specified weight rate of fluid through a pipe is less at high pressure than at low.

When the pressure is changing continuously along the length of the pipe, the potential required per unit length varies accordingly for gases. Eq. (13) can be interpreted as defining the average density to be used in evaluating the flow resistance or in converting potential from units of energy to those of pressure drop.

While the use of the arithmetic mean average density is correct, several alternative practices are more convenient if the fractional change in pressure is not great. For example, if $(P_1 - P_2)/P_1$ is less than 0.1, the fluid can be treated as noncompressible[3] and the density considered to be unchanging. This can be based on either inlet or outlet conditions whichever we find more convenient to use. However, use of the lower pressure and the lower density based on it correspond to a higher potential requirement and are, therefore, more conservative for design purposes.

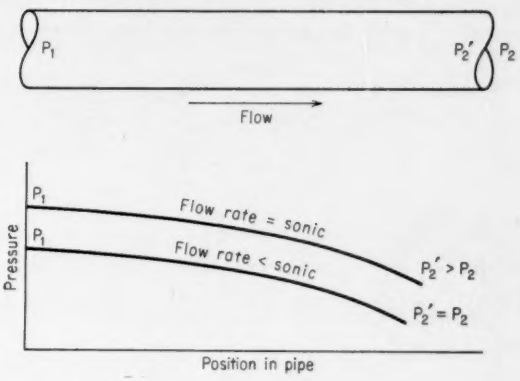
$$\Delta P_f = \frac{4fLw^2}{2g_cD^5(\pi/4)^2\rho^2} \qquad (15)$$

For moderate changes where $(P_1 - P_2)/P_1$ is in the range of 0.10 to 0.40, reasonable accuracy results from the use of an average density[3, 4] defined as:

$$\rho_{avg} = \frac{1}{V_{avg}} = \frac{1}{\frac{1}{2}(V_1 + V_2)} = \frac{2}{(1/\rho_1) + (1/\rho_2)} \qquad (16)$$

In all cases, there is little change in f with pressure because f which depends on the Reynolds number is independent of linear velocity and density. Variation in f is caused only by change in viscosity. Changes in temperature or pressure may cause change is viscosity but only to a small extent. To correct for this small variation, f should be taken as the arithmetic average of its value at the inlet and outlet conditions.

Sonic Velocity Limits Discharge Rate

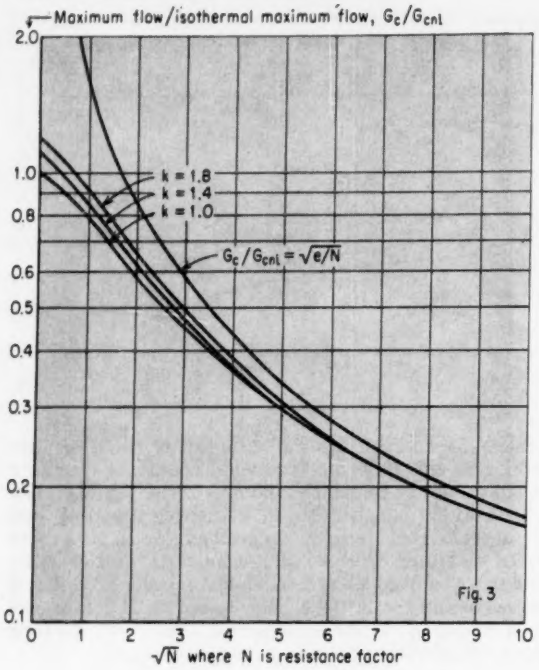


Consider Limiting Fluid Velocity

Limiting velocity in compressible flow occurs when conditions are such that the fluid attains its sonic velocity. At this flow rate, the pressure drop has a value that, when subtracted from the upstream pressure, gives a pressure greater than, rather than equal to, the dicharge pressure. The gas or vapor cannot accelerate further to increase the pressure drop so as to use the total available pressure difference. This may be shown qualitatively by sketching the variation in pressure vs. the position in the pipe.

This phenomena may occur in the venting of reactors, flow through relief lines, valves and other equipment. Since the linear velocity increases as the pressure decreases, limiting or sonic velocity is attained at the discharge end of a straight pipe or in the constriction of valves, orifices and other passages.

Lapple Chart Yields Maximum Flow



It may be predicted quantitatively by the following equations:

$$v_e = (kg_cRT/M)^{0.5} \quad (17)$$

$$G_e = (kg_cMP^2/RT)^{0.5} \quad (18)$$

In Eqs. (17) and (18), $k = C_p/C_v$. Units for v_e are fps. and for G_e are lb./(sec.)(ft.).[2]

Fluid velocity can exceed the sonic velocity and become supersonic, as in wind tunnels, only if specially shaped nozzles are provided. Eq. (17) is readily evaluated if the flow is isothermal. However, if the flow is adiabatic, the drop in temperature necessary to increase the kinetic energy[5] must be taken into account.

Lapple[6] shows how the appropriate thermodynamic relations can be utilized and presents charts for predicting the maximum flow and downstream pressure. As shown in Figs. 2 and 3, these are in terms of the dimensionless ratios: $N = 4fL_{eq}/D$; $k = C_p/C_v$; G/G_{cnt} and G_e/G_{cnt}. G is the actual flow rate in lb./(sec.)(ft.)^2 and G_c is the limiting rate. G_{cnt}, a hypothetical quantity, is the flow that would result if the fluid were allowed to expand isothermally through a nozzle. It is convenient to use and is readily evaluated in terms of the initial conditions.

$$G_{cnt} = P_1(g_cM/eRT_1)^{0.5} \quad (19)$$

Problem 3 illustrates the use of these equations and the Lapple charts for compressible flow.

Problem 3—Pure oxygen is to be supplied to a processing unit through an 80-ft. equivalent length of 1-in. Schedule 40 steel pipe. Oxygen is furnished from a supply main under conditions such that it enters the 1-in. pipe at 150 psia. and 86 F. Calculate the maximum rate at which the oxygen will flow to the unit if: (1) the unit operates at 75 psia. and (2) if the processing unit operates at atmospheric pressure.

1. Processing unit operates at 75 psia. Calculate Reynolds number in terms of G which equals $v\rho$. Hence, N_{Re} equals $7{,}230G$. For reasonable values of G, N_{Re} is approximately one million.

Assuming a roughness ratio ϵ/D equal to 0.0018, we find friction factor for N_{Re} equal to 10^6 to be approximately 0.0056. This friction factor now enables us to calculate the dimensionless constant N.

$$N = 4fL_{eq}/D = 20.3$$

To find G/G_{cnt} and G_e/G_{cnt}, we must calculate the ratio P_2/P_1 which equals 75/100 or 0.5 for this case.

From Fig. 2, we find $G/G_{cnt} = 0.308$ and from Fig. 3, $G_e/G_{cnt} = 0.33$. Since G/G_{cnt} is less than G_e/G_{cnt}, the pressure drop is the controlling factor and we use 0.308 to find mass flow.

$$G_{cnt} = 144 \times 150\left[\frac{32.2 \times 32}{2.718 \times 1{,}544 \times 546}\right]^{0.5}$$

$$= 457 \text{ lb./(sec.)(ft.}^2\text{)}$$

Internal cross-section area of pipe is 0.006 sq. ft. Hence, $G = 0.308 \times 457 = 141$ lb./(sec.)(ft.^{2}) and $w = 0.006 \times 141 = 0.846$ lb./sec.

Check pressure drop by using Eq. (13). Assume P_2 is 75 psia. since intersection of $N = 20$ and $P_2/P_1 = 0.5$ in Figs. 2 and 3 shows pressure drop to be controlling.

$$P_1 - P_2 = \left[\frac{(0.846/0.006)^2}{32.2}\ln\frac{150}{75} + \frac{20(141)^2}{64.4}\right]\frac{1}{\rho_{am}}$$

If P_2 is 75 psia., average density $\rho_{am} = 0.614$. Hence, pressure drop is:

$$P_1 - P_2 = \frac{426 + 6{,}150}{0.614 \times 144} = 74.5 \text{ psi.}$$

2. Processing unit operates at atmospheric pressure. Values of $N = 20.3$ and $G_{cnt} = 457$ are the same as in the first part of this problem. Pressure ratio P_2/P_1 equals 14.7/150 or 0.0981.

From Figs. 2 and 3, find G/G_{cnt} and G_e/G_{cnt}. The value for each ratio is 0.33. Hence, flow rate is limited by sonic velocity at temperature of T.'

Since G_{cnt} equals 457 lb./(sec.)(ft.^{2}), we find the flow rate for these conditions to be 0.33×457 or 153 lb./(sec.)(ft.^{2}) which corresponds to a mass rate w in the 1-in. pipe of 0.918 lb./sec.

To check pressure drop for this rate, we find that a trial-and-error solution is most convenient since P_2 appears in several terms. Let's assume P_2 equals 35 psia. At this pressure average density of the gas is 0.505 lb./cu.ft. Substituting numerical values in Eq. (13) and solving gives pressure drop $(P_1 - P_2)$ equal to 115.5 psia. Hence, $P_2 = (150 - 115.5)$ or 34.5 psia. compared to 35 psia. originally assumed.

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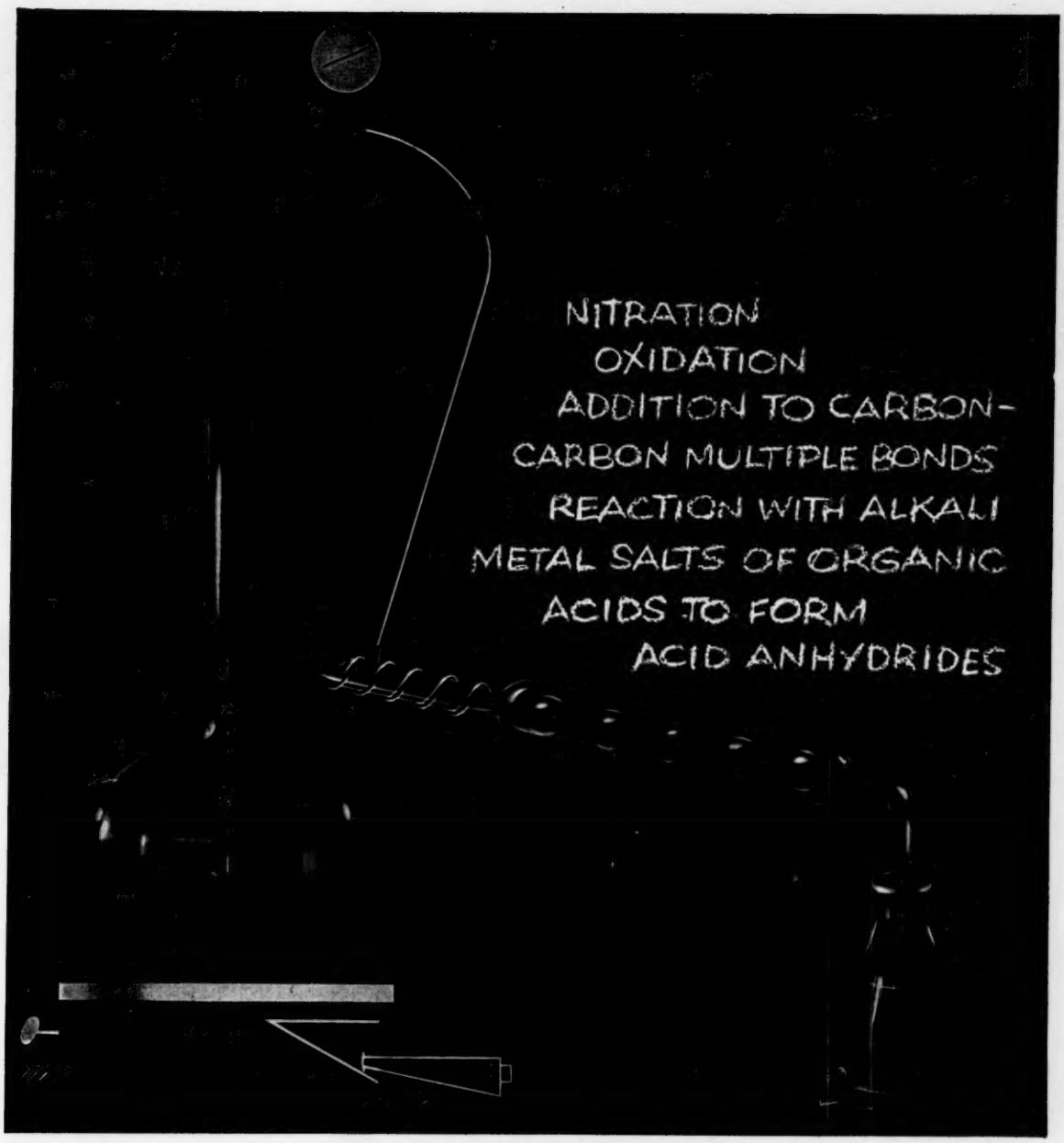

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Freezing Point	−11.3°C
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Critical Pressure	99 atm.
Specific Heat of Liquid	0.36 cal/gm−10 to 20°C
Density of Liquid	1.45 at 20°C
Density of Gas	3.3 gm/liter 21°C, 1 atm.
Vapor Pressure	2 atm. at 35°C

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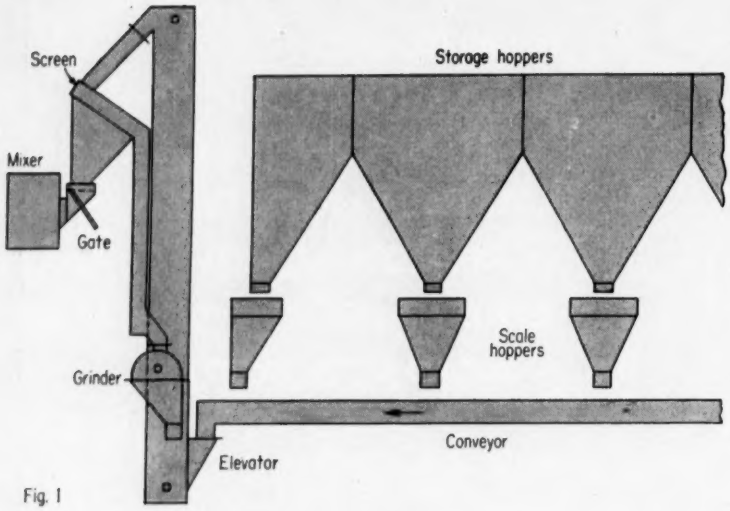

Fig. 1

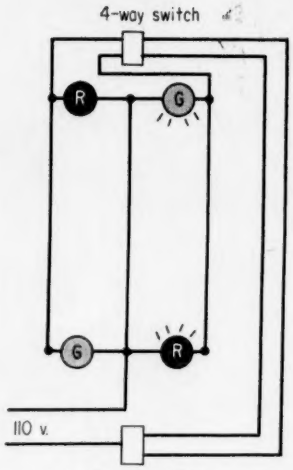

Fig. 2

Signals Coordinate Batch Operations

Simple electrical hookup makes it possible to alternate signal lights at two locations. Typical example is in batching of mixed fertilizers.

Chesman A. Lee, Engineer, Evanston, Ill.

Sometimes batch operations require the correlation of certain process steps by two operators. In such a case a foolproof signal system between the operators is likely to be very handy. This article describes a simple method of signalling and a case in which it was necessary.

Fig. 1 shows a batching and mixing system for mixed fertilizer where we needed better coordination between the scale man and the mixer man. The wiring diagram, Fig. 2, shows the red-and-green-light signal system developed to keep each man informed of the process state.

The process involved weighing out the various ingredients in scale hoppers; dropping the materials to a conveyor and elevating them to a screen; collecting the "through" material in the mixer charging hopper; regrinding and re-screening the oversize until all material would pass the screen; and finally dropping the entire batch to the mixer. The scale man needed to know that the last batch had left the mixer charging hopper before he could start a new batch up the elevator. And the mixer man needed to know that the batch had been delivered completely to the mixer charging hopper before dumping it to the mixer.

A system such as this depends on close chemical control, which in turn depends on good sampling. Good sampling requires that each batch be like every other batch. Hence, it is important that a batch should not be allowed to enter the mixer before the last batch is out. The signal system insured this effectively.

Near each operator was a switch and a pair of signal lights, red and green. The trick lies in the switches. One was a common three-way switch, the other a

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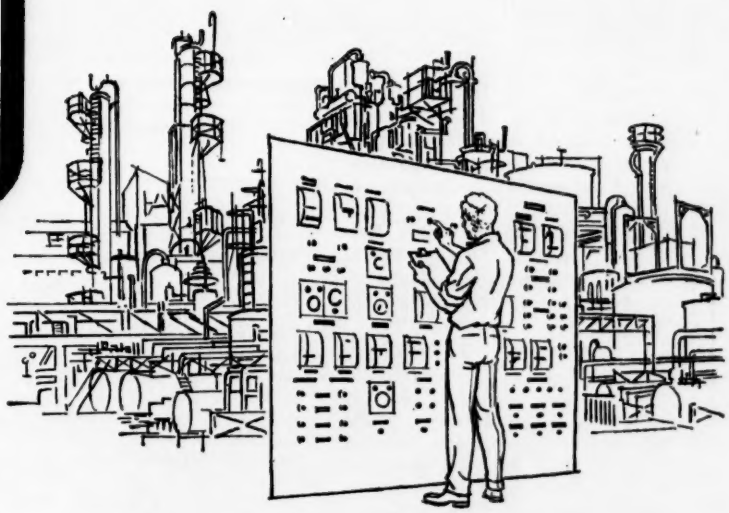

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four-way. If either switch was flipped, both pairs of lights would change. For example, if red showed at one location, green would show at the other. Then flipping either switch would produce the opposite light display.

Let's follow through one operating cycle. Assume we are starting up. The scale man weighs up his first batch while the mixer operator is getting ready. When the latter is ready and his charging gate is closed, he flips his switch and the scale man's light turns green. The scale man starts dumping so as to keep the elevator feed chute partly filled.

Tailings will recirculate until all oversize has been reduced to pass the screen. When the elevator boot is empty, indicating that the batch is all in the charging hopper, dust will stop rising from the feed chute and the scale man will flip his switch, turning the mixer operator's light green. As soon as the latter has dropped the batch to the mixer and closed the gate, he flips his switch, the scale man's light turns green and the cycle continues as described.

Select a Better Gasket For Liquid Oxygen

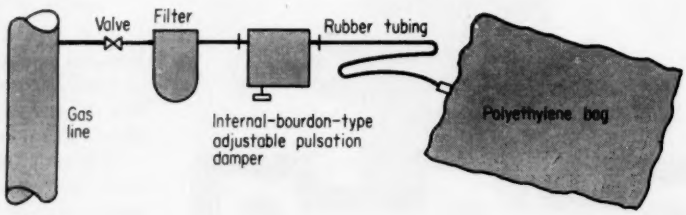
Paul C. Ziemke
Engineer, Clinton, Tenn.

We were using large quantities of liquid oxygen in reactor research work and it soon became clear that an experimental program on flanges and gasketing would be needed to insure dependability. We found that lead, dead-soft aluminum, Teflon, Kel-F and a combination of Teflon and asbestos could be used successfully for most exposures to very low temperatures.

We also found that flange design was very important, together with the finish of the matching surfaces and the bolting pressure used. The latter is critical since it must be high enough to compensate for the low-temperature thermal distortion of the flanges. Whenever clearance was available, we used torque wrenches in bolting up the flanges. No vegetable or mineral oil was permitted at any time and graphite was used only sparingly, if needed.

Stainless steel flanges of conventional design worked out well in most installations. We found that phonograph-type serration on the flange faces was the finish most difficult to keep tight in oxygen service—but that good workmanship could overcome the difficulty with $\frac{1}{16}$-in. sheet lead, Teflon and Teflon-asbestos.

In our tests we prepared a 6-in. nipple sealed with gasketed flanges and pressurized to 20 psig. We placed this in an evacuated chamber held at 30 in. vac. and followed the decay rate with thermocouples which measured the temperature gradients on the flange assembly during the flange cool-down time. In general, best results were obtained with concentric flange serrations.



Composite Sampler for Gases

P. E. Kline, Dow Chemical Co., Midland, Mich.

In our plant we have tried various schemes for obtaining a 2- to 4-cu. ft. composite sample of gas over a seven-day period. No other method has worked as well as the setup shown in the sketch above.

The secret to obtaining a very small and steady flow of gas is to use an extremely sensitive and reliable valve. We have found that the Foxboro internal-bourdon, adjustable pulsation damper fills the bill nicely. It takes a little experimentation with the damper to get the desired flow rate. But, then, it will hold a flow as low as 1 cu. ft. per week.

Coming Sept. 7: Better Way to Lead-Line Wooden Tanks

By Albert E. Hughes, Winner of the Midsummer Contest

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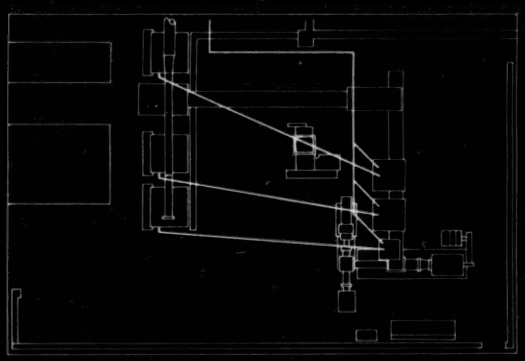
FORD MOTOR COMPANY
installs BAKER PERKINS machinery for
continuous production of re-inforced plastic pre-mix

To achieve all the advantages of automatic processing, Ford Motor Company has installed a completely integrated system for the production of re-inforced plastic pre-mix on a continuous basis. A Baker Perkins Ko-Kneader has successfully solved this tough mixing problem and is the key piece of equipment in the system. Because of this remarkable technical accomplishment, it has been possible to achieve a whole new concept in automated pre-mix production. Baker Perkins supplied all the auxiliary equipment for conveying, weighing and feeding the component materials which included resin, sisal, clay, asbestos and calcium carbonate, as well as the equipment for forming and cutting off the pre-mix after discharge from the Ko-Kneader.

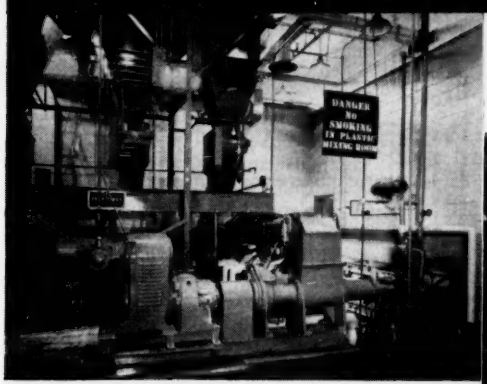
The machines of Baker Perkins manufacture in this installation include: four dump hoppers, complete pneumatic conveyor systems, belt transfer conveyor, resin pump and a model K-250-IM Ko-Kneader.

With this new automated system, Ford Motor Company has been able to capitalize on all the advantages of continuous processing and achieve a production rate of 1800-2400 lbs. of high quality pre-mix per hour. You, too, may be able to utilize the many advantages of the Ko-Kneader for continuous processing. Why not write today for complete information.



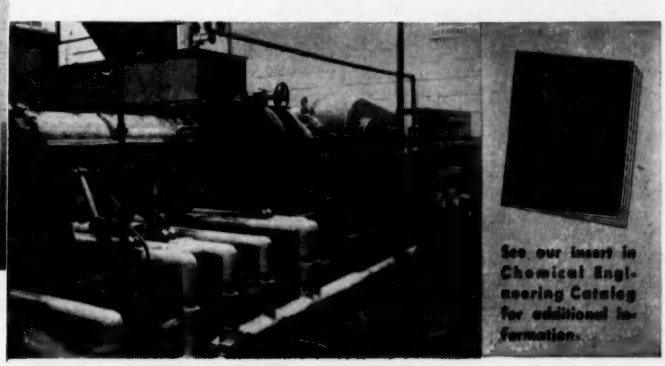
This diagram illustrates the continuous mixing system as installed at Ford Motor Company.

From these B-P dump hoppers the asbestos, clay and calcium carbonate are conveyed by a Baker Perkins pneumatic system to the mixing room. The sisal (second from the left) is moved by a mechanical conveyor.



Close up view of the Baker Perkins model K-250-IM Ko-Kneader. Feed conveyor is at the top, center. Discharge is at extreme lower left.

Overall view of mixing room. The overhead feeders discharge measured amounts of material on conveyor discharging into the Ko-Kneader.



See our insert in Chemical Engineering Catalog for additional information.

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W. K. Whiteford, pres	175,000	128,110	175,000	142,548
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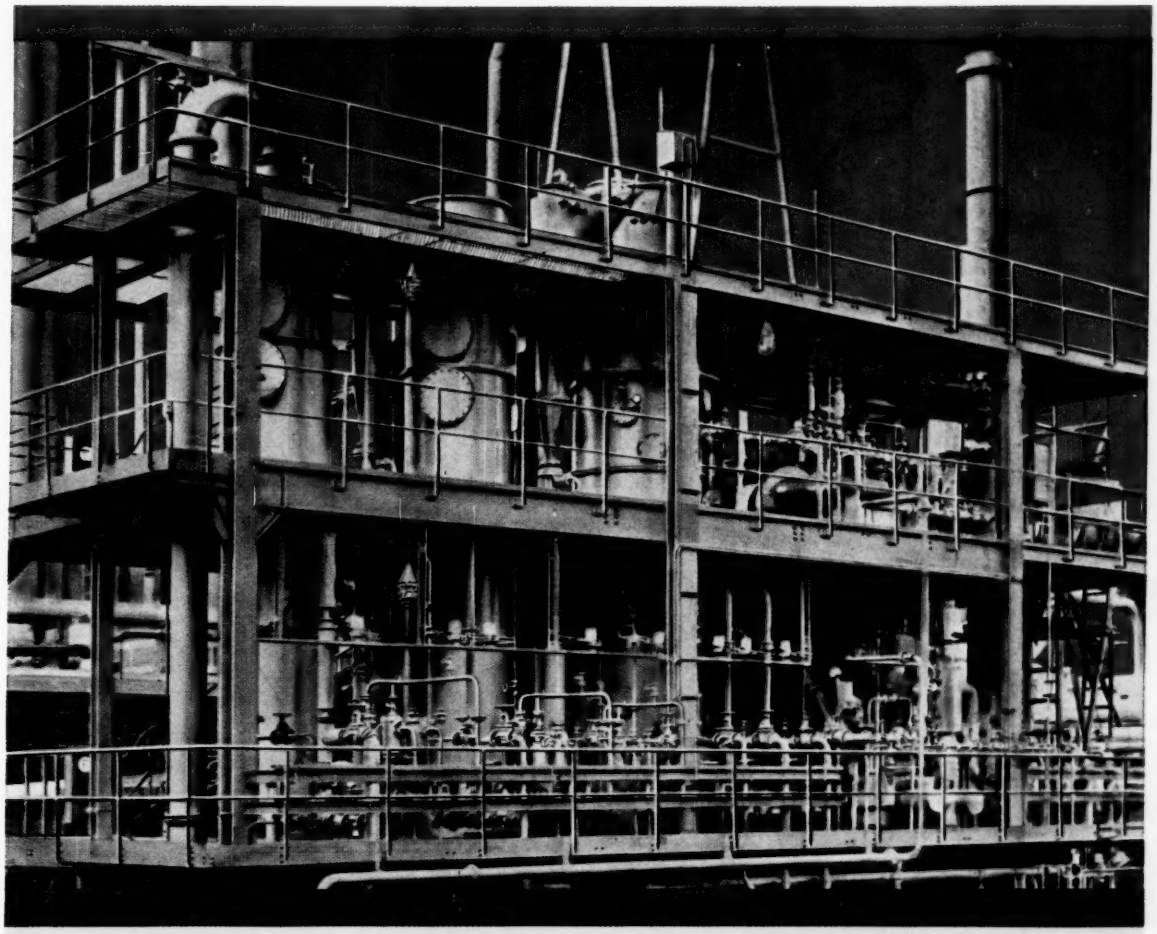
Top man in many a company took it on the chin. Lower pay levels in 1958 showed up mostly among the chief executives. Fewer of the top brass made more than $300,000, and one corporation president (automobiles) took a cut of more than $250,000. For comparison, in 1955 three men reached $700,000 in total compensation for the year.

Second echelons did better. As many companies seemed to be raising pay levels as cutting them; and in some the top man fared worse than those below him.

One of the notable absentees from the top-compensation club for 1958 is chemical engineer Crawford H. Greenewalt, president of the Du Pont Co. Usually one of the highest-paid executives in the U. S., Greenewalt received salary and cash bonus in 1957 amounting to $320,942. Last year the total came to only $298,116. (But Greenewalt also got



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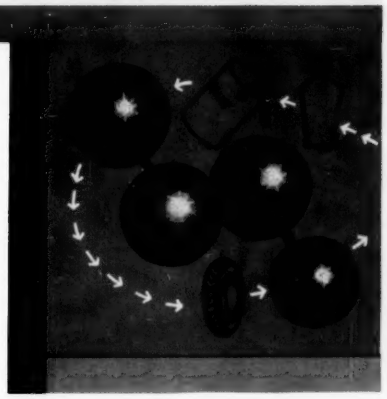

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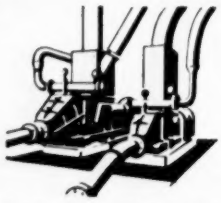

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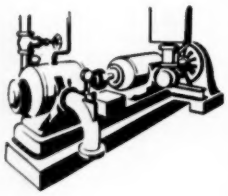
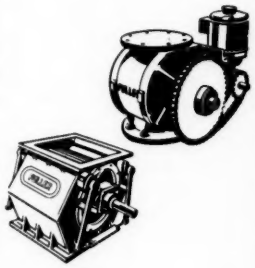
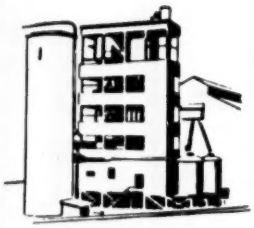


Fuller Rotary Compressors and Vacuum Pumps are vibration-free, can be installed anywhere, even on balconies. Fewer moving parts mean minimum maintenance. Compressors and Vacuum Pumps handle air and gases from 30 to 3300 cfm at pressures to 125 lb. gage. Vacuums to 29.95 in. (referred to 30-in. barometer).

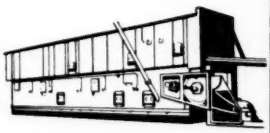
Fuller Vane-type and Roll Feeders . . . for volumetrically controlled feeding of a wide range of dry pulverized or granular materials. Also Fuller Rotary Valves . . . used under silo deck slabs and bins to permit the free flow of pulverized materials which tend to arch, such as lime and cement raw materials.





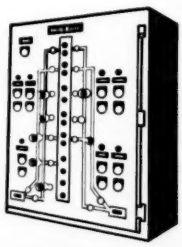
Fuller Preheaters, Humboldt Suspension Type . . . for preheating dry, pulverized Portland cement raw materials with rotary kiln waste gases.

Fuller Horizontal and Inclined Grate Coolers are compact, easily installed for fast, efficient cooling of materials such as nodulized phosphate rock, pebble lime, ores, dolomite, iron nodules and Portland cement clinker from 2800°F. or higher to any desired point within a reasonable range of atmospheric temperature.



Fuller-Material-Level Indicators signal audibly and visibly when materials reach a predetermined high or low level. Controls conveyor motors, valve circuits, etc.

Fuller Control Panels permit automatic, remote, one-man control of multiple operations. Easily-read panel permits visualizing flow of material to storage or from process bins.



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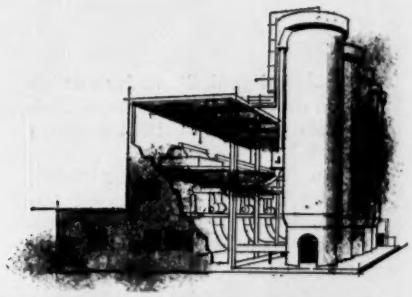

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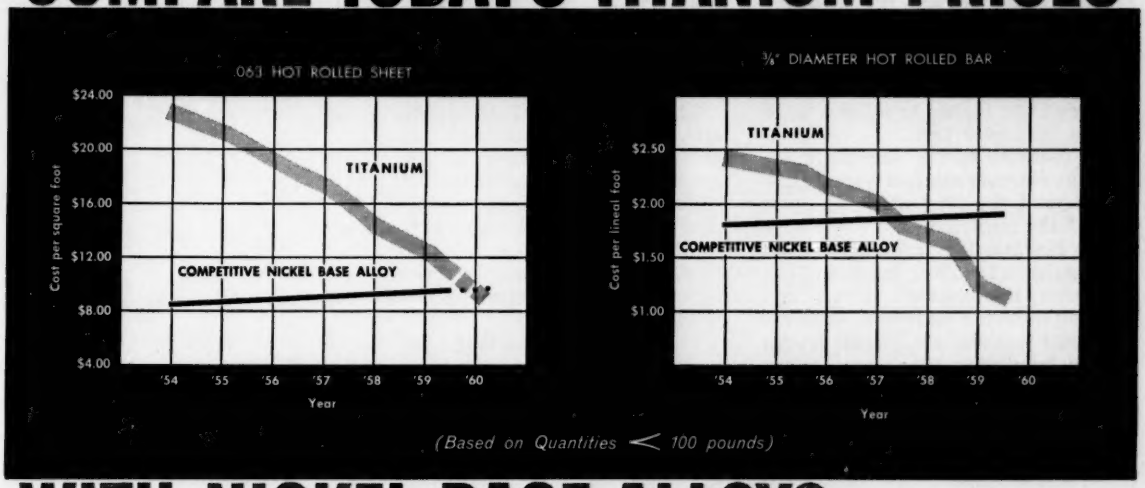
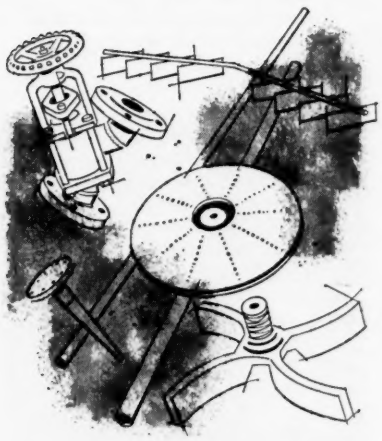


WITH NICKEL BASE ALLOYS



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"dividend units" under which he'll collect the equivalent of dividends paid on Du Pont common stock.)

In the accompanying table, we've listed salary data for top executives of some representative chemical process industry companies.

Starting Salaries Up Again

Although there was a slight decrease in the number of companies recruiting on our college campuses last spring, the total number of positions that recruiters were trying to fill was up 5 to 10% over 1958.

Because of the demand, average starting salaries were up 2% beyond the 1958 highs, in spite of the recession.

Engineering graduates were again on the receiving end of the better-than-average offers. Starting pay for engineers in June 1959 was about 4% higher than in June 1958. This would put the average starting rate for new chemical engineers at just about $500 a month.

For comparison with nontechnical graduates, we have these figures from H. Glenn Ludlow, Bureau of Appointments and Occupational Information, Univ. of Michigan:

"The average salary offered those interested in sales and management training programs this year is $400 a month, with individual offers ranging from $338 to $460."

(Engineers start higher; but somewhere along the way, it seems, these sales and management trainees must speed past them.)

Ludlow characterized this spring's recruiting atmosphere this way, "Students have become more punctual and serious in their interviewing, putting forth more effort to land a job than was the case two years ago. They're also getting better informed about companies before interviewing them."

Engineers Do Get Overtime

Contrary to popular belief, companies do compensate engineers, supervisors and management personnel for overtime work even though they are under no legal obligation to do so.

Of 434 companies that replied to a recent American Management Assn. (AMA) survey on overtime compensation practices, 224 (52%) reported that they grant payment or time off for overtime work to employees exempt from pay provisions of the Fair Labor Standards Act. The five major categories of employees covered in the survey are: factory first-line supervisors; clerical first-line supervisors; salaried professionals; middle-management personnel and top-management.

The survey shows that, in general, the larger the company the greater the likelihood of its granting overtime pay to exempt employees. Of the large companies (> 5,000 employees) 72% of the companies reported that they grant overtime compensation to the five groups of employees listed above.

Companies with less than 1,000 employees were classified as small by AMA. Of these companies, 41% reported that they pay overtime. In the middle group (1,000-4,999 employees), 57% said yes.

Straight Time Most Popular

Most frequently used basis for computing overtime compensation for all categories of exempt personnel is straight time. The method used least is time off. Other methods reported are time and one-half and payment according to a sliding scale based on an inverse function of base salary.

Salaried professionals are compensated by 148 companies in the survey on the following basis: straight time, 36%; time and one-half, 22%; sliding scale, 13%; time off, 5%.

Of the ten companies that checked top-management personnel as one of the groups that receive overtime compensation, four mentioned time off as the method of compensation. Companies that said monetary payment is given, in most cases also mentioned salary limits beyond which compensation practices do not apply. Therefore, it's highly unlikely that all top executives in these companies actually receive compensation for overtime work.

A Special Feature of
You & Your Job

Ivan and His Job

MOSCOW — (McGraw-Hill World News) — Soviet design organizations are harboring ineffective engineers—"Babbitts in science"—in high posts, according to the influential State newspaper *Izvestia*.

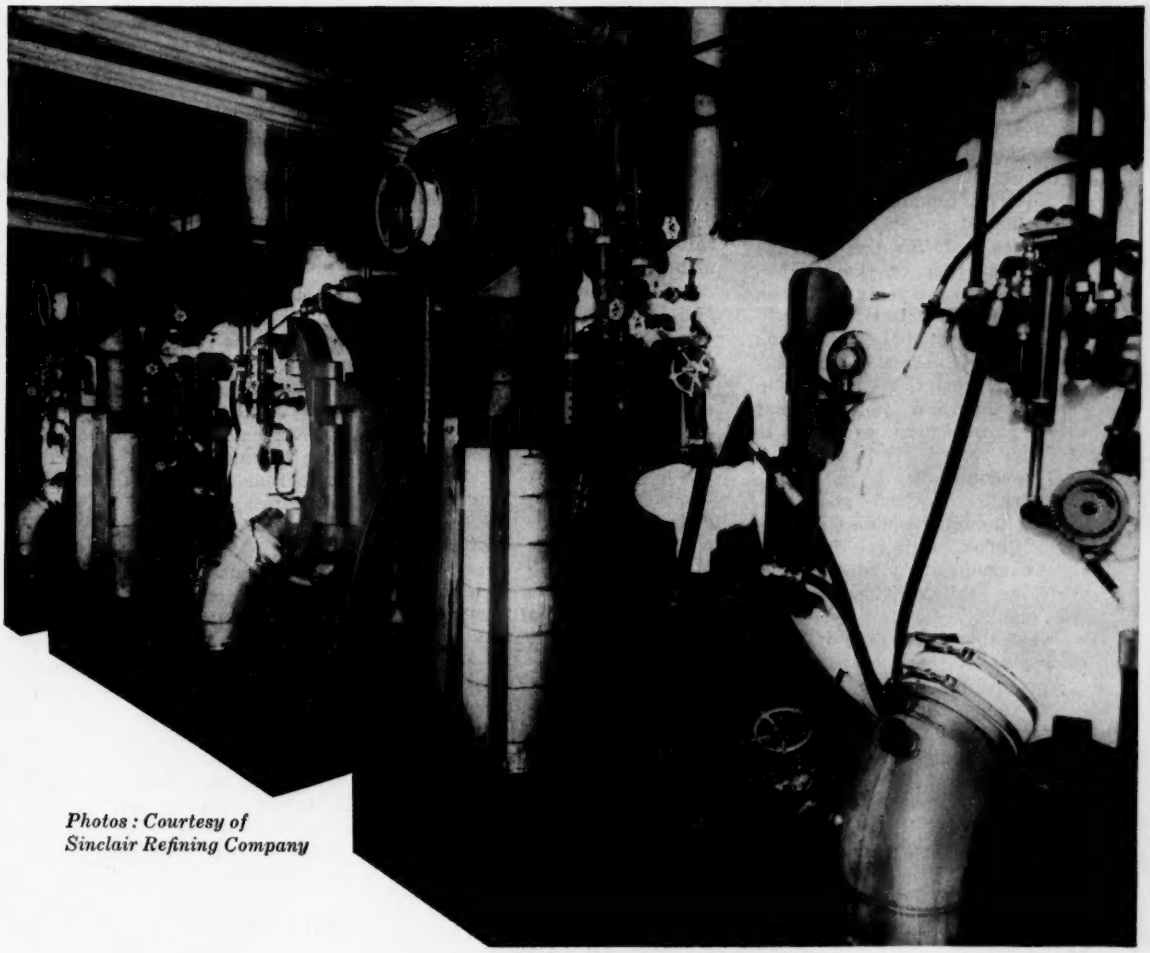
The publication cited one of Russia's primary research institutes, the Machine Tool Institute (ENIMS), as an example in a vitriolic 2,000-word blast.

Izvestia charged that educated goldbrickers, after earning university degrees, are "taking cover in the supposed complexity of the problems they are supposed to solve, producing naught; and at the same time they are blocking advancement of younger, more talented men."

The newspaper said there are two ways of rectifying the situation: either putting experimental work on a cost-accounting basis or having "public organizations" (presumably Communist Party units) "remove all who are simply husks."

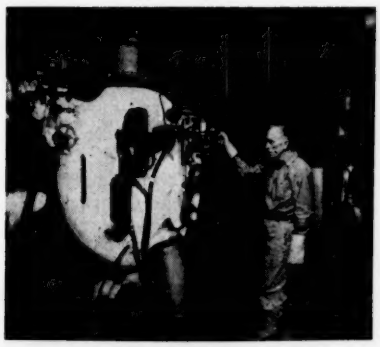
Cost accounting was recommended some time ago, *Izvestia* said, "but this method of control is taking feeble root at our research institutes."

Two offenders on the staff of ENIMS were named. One of them, Valerian Petrovich, was accused of treating his work "merely as a livelihood." Here are some details.



Photos : Courtesy of Sinclair Refining Company

LOW TEMPERATURE PETROCHEMICAL OPERATION



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The battery of Sharples C-41 Super-D-Hydrators illustrated above is in operation at one of the plants of Sinclair Refining Company.

The C-41 Super-D-Hydrator—Another Sharples Exclusive

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Valerian Petrovich, about 45, finished a higher technical school education, then worked for two years as shop technician at an engineering foundry. After that, he defended a dissertation, won a degree and, for the last five years, has been on the ENIMS staff. "These five years," *Izvestia* says, "he has spent on a purely theoretical theme and the period has been fruitless. There has been no gleam of novelty in his experiments, nothing that could interest other engineers in foundry work."

"He does not like it at the foundry," *Izvestia* goes on. "Even though he has an assignment linked with the technical improvement of foundry production, he seldom makes visits to the plants."

Then there's the case of V. M. Misozhnikov, head of a plastics laboratory at ENIMS and formerly employed at the Institute of the Instrument-Making Industry. "In the space of three years he has not forged even a micron ahead."

These men are not rare exceptions according to *Izvestia*. "There are also other self-styled 'scientists' who have not enriched science or production with even one bright idea and who are way behind the advanced people of the country."

It was implied that there was also trouble at the Central Heavy Machinery Research Institute. It is said that not one of the 150 masters of science or 12 doctors of science on the institute staff has reported on his work in the past year.

Izvestia implied that the institutes retain inefficient staff personnel because they are "reluctant to wash their dirty linen in public.

"The hushing up of things often gives rise to lobbying, gossip, complaints, stool-pigeoning, to squabbling and bickering. Sometimes the atmosphere grows red hot and everybody's peace of mind is disturbed. Heaven knows when the steam of healthy indignation will fling off the scum. Meanwhile matters stand still."

CE's Comment — People are people, everywhere. We don't like it very much at the foundry either.

ENGINEER TITLE

. . . to Be Restricted

"The use of the word 'Engineer' in a job title on a business card, letter, or in any other manner, if it is to be communicated to the public, is permissible only if the person is a registered engineer. 'Communication to the public' means any communication outside of the company either verbal or written."

The policy directive stated above was recently issued by the Butler Mfg. Co. of Minneapolis for the express purpose of complying with the engineering registration laws of the State of Minnesota.

Special rules were formulated for the sales department, specifying that sales personnel of the company will not use the title "Sales Engineer" on business cards or correspondence, unless the individual is a registered engineer.

Graduate, but unregistered, engineers performing sales functions will use the title "sales service representative," but they will carry under their title the legend, "graduate engineer."

CLASS OF 1962

. . . Why They Weren't

As reported in *Chementator* soon after the start of the school year (*Chem. Eng.*, Dec. 15, 1958, p. 67), enrollment of engineering freshmen was down an estimated 13% from the previous year. Meanwhile, for all college freshmen enrollment went up 7%.

Final refinement of the data by Henry H. Armsby, Chief for Engineering Education, U. S. Office of Education, now pares the loss figure for engineering to 11.1%, on the average. The decline was greater proportionately in the schools accredited by Engineers Council for Professional Development; and the large schools reported a higher casualty rate than the small schools. Geography also had an effect. The South fared better than the rest of the Nation.

When the trend became evident last fall, Engineering Manpower Commission and the American Society for Engineering Education joined forces to dig out the underlying reasons for the drop in engineering candidates. They obtained opinions from 150 deans of engineering schools. Here are the conclusions:

- Main causative factor for the drop in engineering enrollment in the fall of 1958 was a false appraisal of the long-range engineering career opportunities by career counselors, students and parents.

According to the deans, the false appraisal was based on the "numerous references in the general press last spring to the alleged large-scale layoffs of engineers."

- Increased concern about the rigors of the engineering curriculum, was a second factor. High school students are beginning to spread the word around that engineering is a tough course.
- Increased interest in science. According to the popular press, scientists are doing everything that is important or glamorous today. Engineering achievement is rarely identified as such.

MILLIONS

. . . for New Buildings

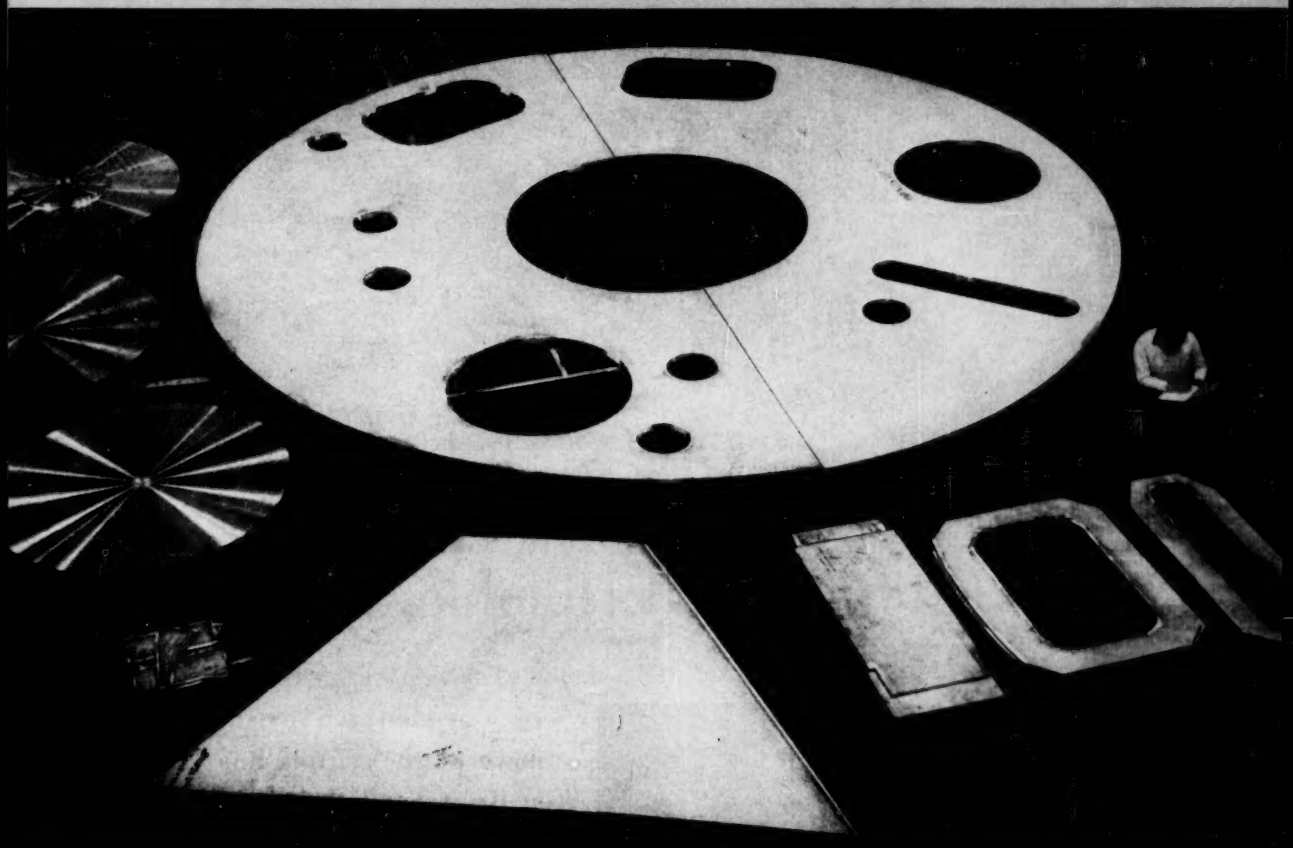
Ground has been broken for a new chemistry and chemical engineering building at Armour Research Foundation of Illinois Institute of Technology. When completed late in 1960, the structure will contain 144,000 sq. ft. and will have cost more than $3.5-million.

Joe Koffolt, chairman of the chemical engineering dept. at Ohio State University, Columbus, has announced that by the beginning of 1960 his department expects to have most of its area in the new Chemical Engineering and Mineral Industries Building in operating condition.

Construction work is progressing satisfactorily on the $4.4-million structure which, when complete, will house OSU's chemical engineering (with petroleum engineering), metallurgical engineering, ceramic engineering and mineralology departments. Formal dedication is scheduled for engineers' day next May.

final check

on your order for stainless steel plate from Carlson



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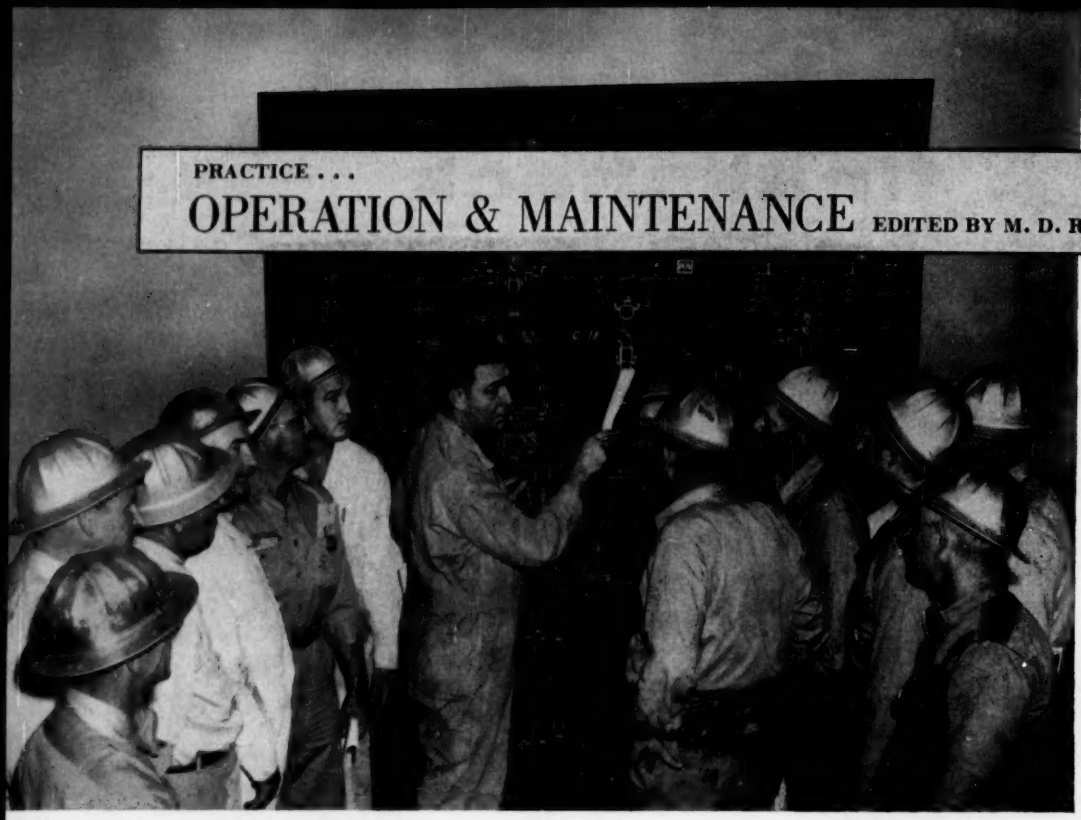
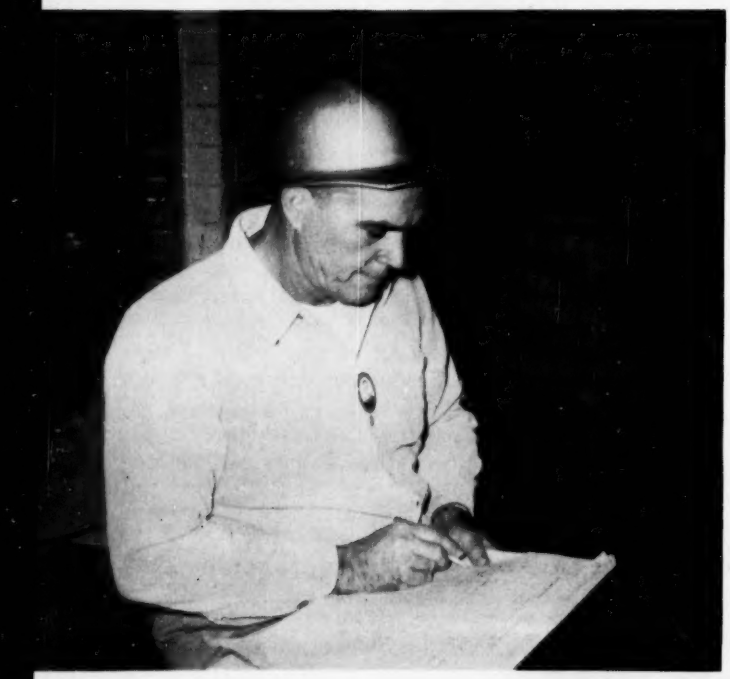


Going On Stream at Humble Oil



Blow-by-blow, you're right down on the starting line at Baytown, Tex., putting a new unit on stream.

LAST MINUTES are ticking away and the operators and engineers bone up on final instructions before going out on the unit to start actual work.

Every last detail is checked from a list of "must" items. Every uncertainty is removed before the start-up signal is given.

At this stage of the game, emergency changes can pop up requiring quick decisions.

CHECKING PAYS OFF

(Turn page)

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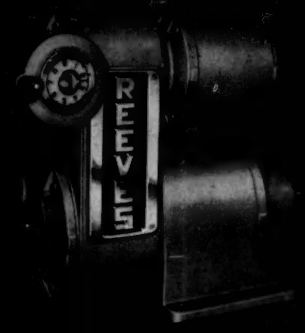
Vari-Speed Motodrives mean versatility in variable speed



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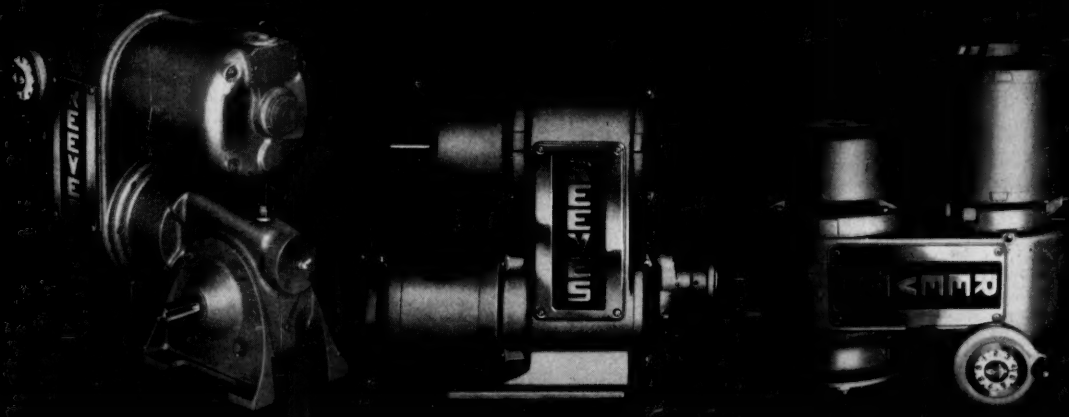

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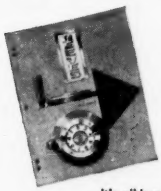
REEVES has the variable speed answer for virtually *any* installation . . . with *standard* Motodrive units. This rugged, compact power package is available from ¼ to 20 hp., 1.7 to 4660 rpm., in 2:1 thru 10:1 speed variations. Single, double and triple stage reducers provide gear ratios from 1.17 to 195:1. Other Motodrive units up to 40 hp.

There's space-saving versatility, too . . . **REEVES** Motodrives come in two styles: "C" flow, as illustrated, and "Z" flow, where motor is on opposite side of the case from the output shaft.

Extra precision . . . a complete line of controls, ie. AIRtrol (a pneumatic positioner), electric remote control, mechanical controls, magnetic brakes and tachometers. **Extra versatility** . . . to meet specific needs, **REEVES** offers a full array of modifications, ie. special motors, shaft extensions and scoop mountings for foot-mounted motors.



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UNIT IS READY and the first furnace is fired up to bring the temperature to operating level in the big unit. Now's the time safety pays its dividends. Conditions are constantly changing and everything's got to be watched that much more closely.

ON STREAM

(Turn Page)

Which valve alloy for your next job?

When you next have a requirement for high alloy valves, especially for corrosion service, why not come to the company with the most experience in this field.

Aloyco has specialized in the manufacture of stainless steel valves, exclusively, for over 30 years.

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***These seven corrosion test specimens** are just a few from hundreds of tests conducted by Aloyco to insure our valve customers of the right alloy for their particular job. Aloyco valves are supplied in such metals as 304 and 316 stainless steel, Aloyco 20, Nickel, Monel and Hastelloy B, C and D.*

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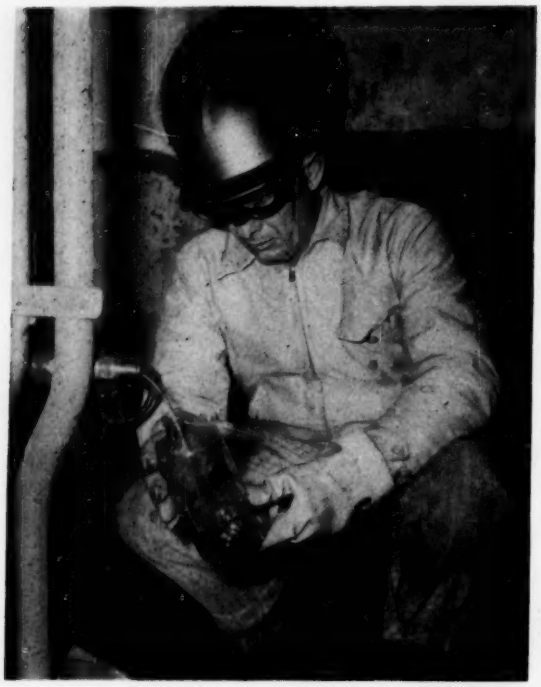
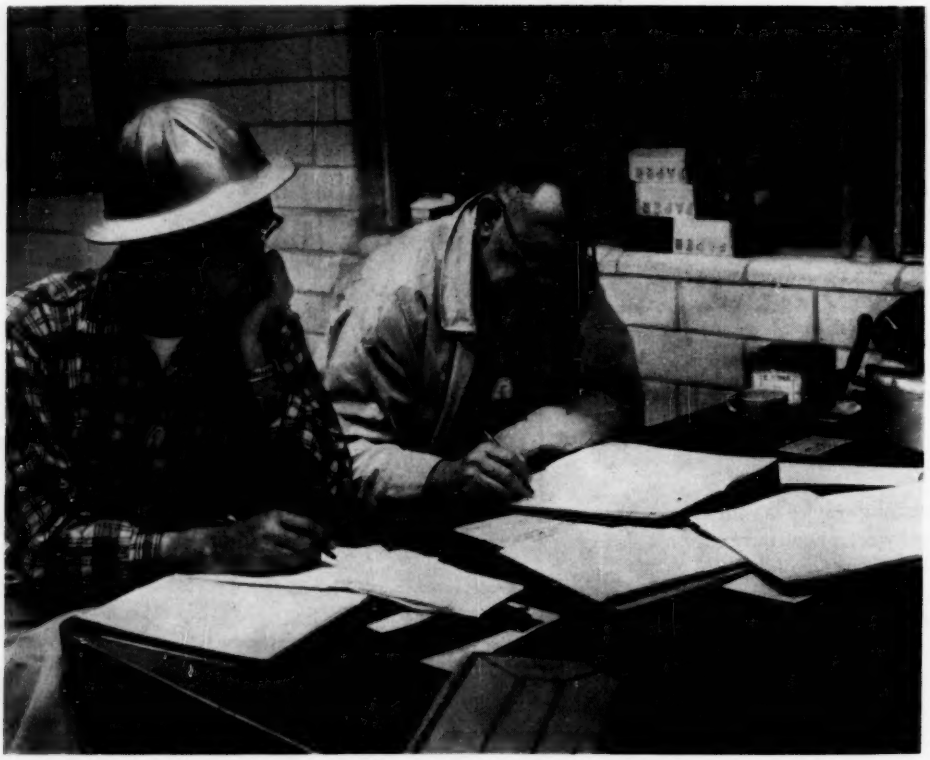


ON STREAM and the first sample is tapped off the new unit. Then, over to the control lab for analysis. Some valve twisting is still necessary at this stage of the game when bringing a big unit like this on the line.

Full production now. Product is logged into the control room's records, computations made and then double-checked. Yields, temperatures, flow rates, pressures—how are we doing?

MISSION ACCOMPLISHED

(Turn Page)



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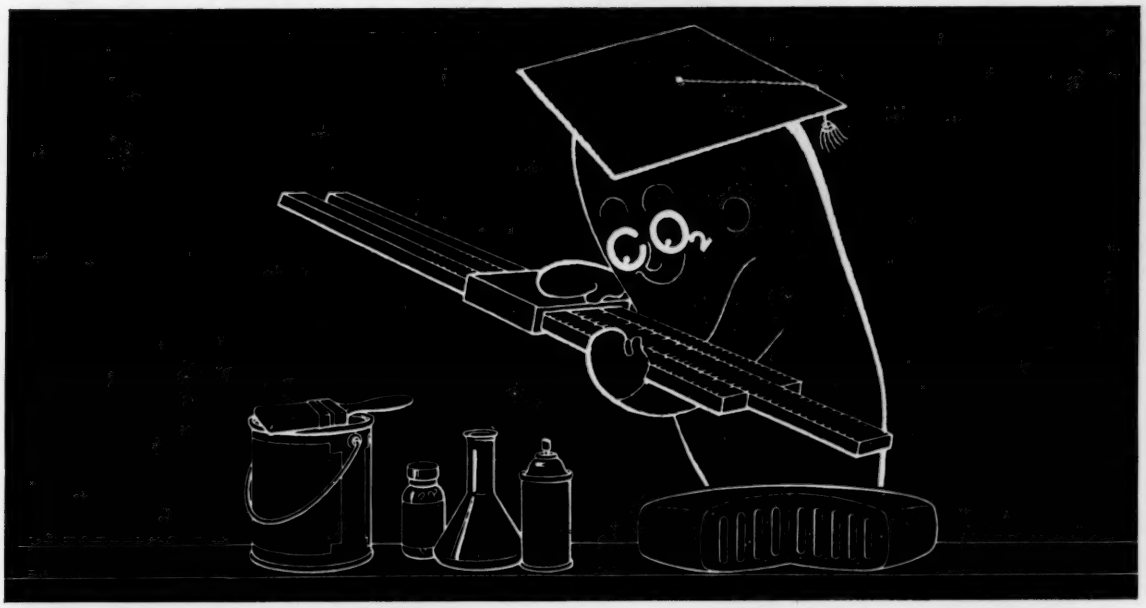

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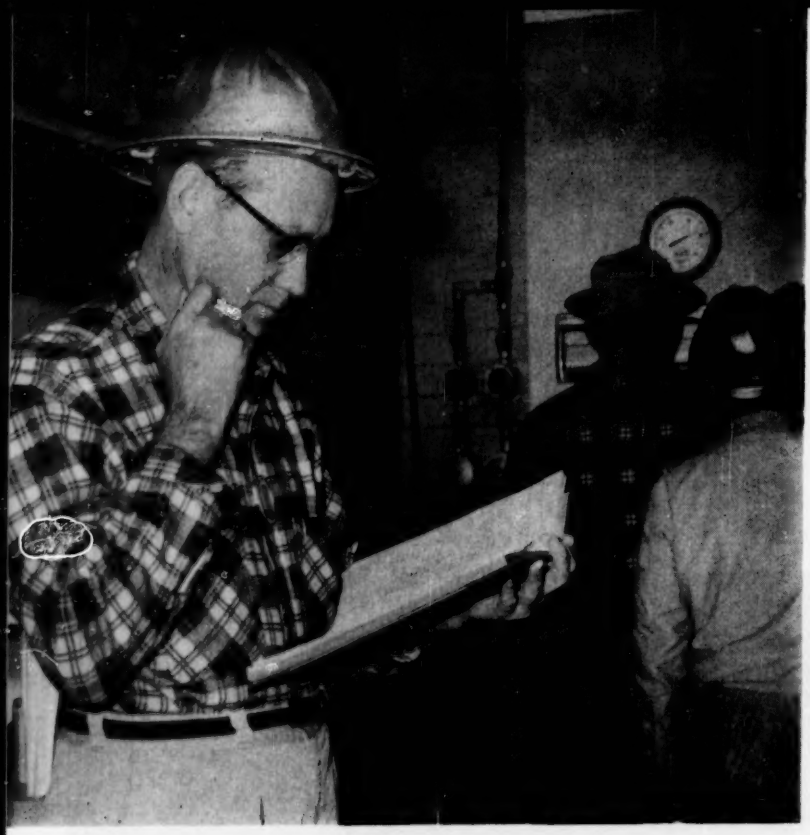
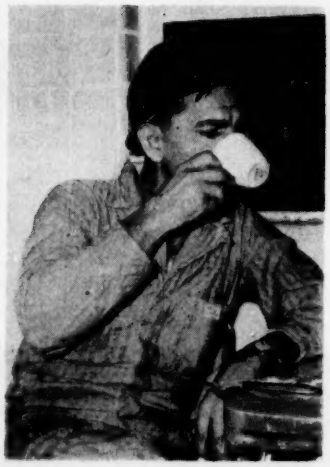
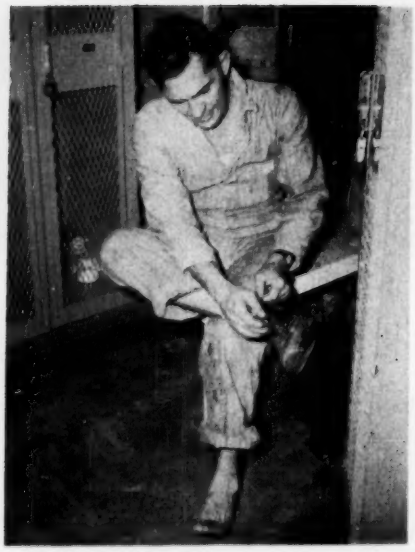




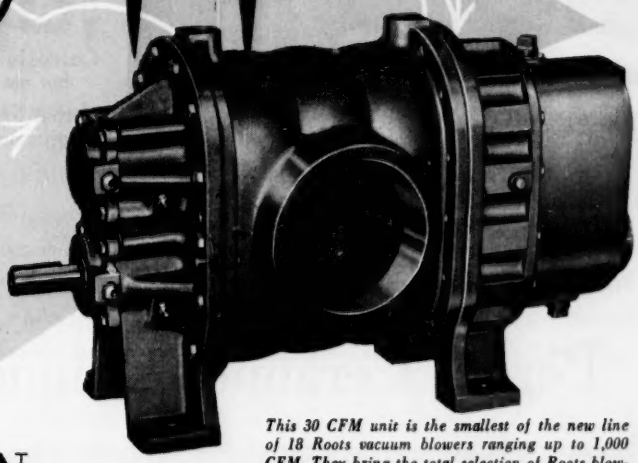
CRITICAL PERIOD of operation requires constant vigil till the unit settles down. Then, a break for some hot coffee.



MISSION ACCOMPLISHED, unit on stream, off to the locker room for a shower. But, here's where a new job just starts. Prompt follow-up gets the maximum benefit from the new experience. Before the operation is routine, the engineers are finding ways to change and improve it.

NOW

for efficient vacuum service as low as 30 CFM...



This 30 CFM unit is the smallest of the new line of 18 Roots vacuum blowers ranging up to 1,000 CFM. They bring the total selection of Roots blowers to 54 sizes...with savings for you in every size.

A BIG SELECTION OF SMALL ROOTS VACUUM BLOWERS

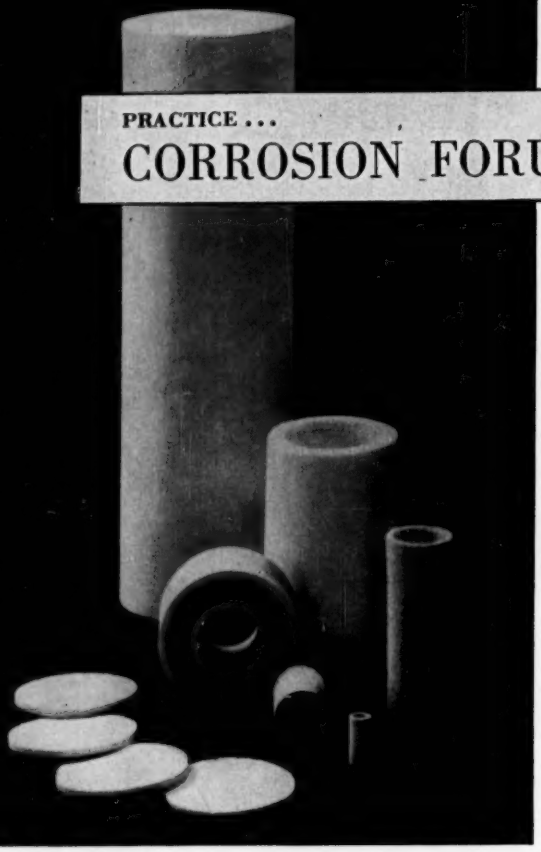
Roots-Connersville adds 18 small-volume vacuum pumps to its already extensive line to give you better selection, better performance in limited-volume applications. This new line is designed to handle capacities ranging from 30 CFM to 1,000 CFM, for operation at up to 20 inches mercury vacuum in single stage construction. These units are designed for compounding for higher vacuum service.

Major features of the larger Roots water-sealed units are retained: simple, efficient design without internal valves, no internal contact between moving parts, normal maintenance limited to oil changes, efficient operating speeds and minimum sealing water requirements. The result is more CFM per dollar.

Only Roots-Connersville offers exclusive rotary positive design and such ease of installation in vacuum blowers of this size. They are now available for a wide variety of application in the food, chemical, petroleum, paper, sewage and industrial waste treatment, mining and other industries.

Your nearest Roots-Connersville sales engineer has full details on this new series of vacuum blowers. Or write for a specification sheet and for Bulletin VP-158 covering the larger units.

ROOTS-CONNERSVILLE BLOWER
DIVISION OF DRESSER INDUSTRIES, INC.
859 Illinois St., Connersville, Indiana. In Canada—629 Adelaide St., W., Toronto



High Temperatures: Can take filtration conditions up to 1,800 F., differential pressures of 600 psig. and up.

Corrosion Resistance: Stands up to most acids, but not to hot alkalis or hydrofluoric acid.

Sharp Separation: A rating of 50 microns means 98% of material larger than 50 will be held back.

Porous Ceramic: Unique Filter Medium

A specially-designed porous ceramic is invading an area of filtration now dominated by porous metals.

Intended primarily for high-temperature, corrosion-resistant filtration, these new ceramic materials can take temperatures of 1,800 F. and differential pressures in excess of 600 psig.

Porous ceramics, of course, are not new. The usual types, however, are incompletely-fired materials. Pore sizes and pore volumes, while controlled, are

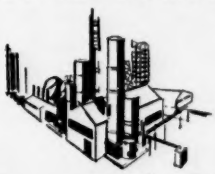
How Porous Metals and **Ceramics** Compare in Filter Service — Table I

	Ceramics	Electrodeposits	Sintered Fiber	Sintered Powder	Sintered Wire Mesh
Cost	1	4	5	3	2
Sloughing tendency	3	4	2	5	1
Cleanability	1	2	4	5	3
Oxidation resistance	1	2	2	2	2
Pore size uniformity	1	4	5	3	2
Ultra-fine filtration potentialities	1	2	4	3	5
Channeling tendency	1	2	4	3	5

Various materials are rated according to their ability with respect to the listed characteristics. Rating of 1 is best. Note for cost 1 is lowest-cost material.

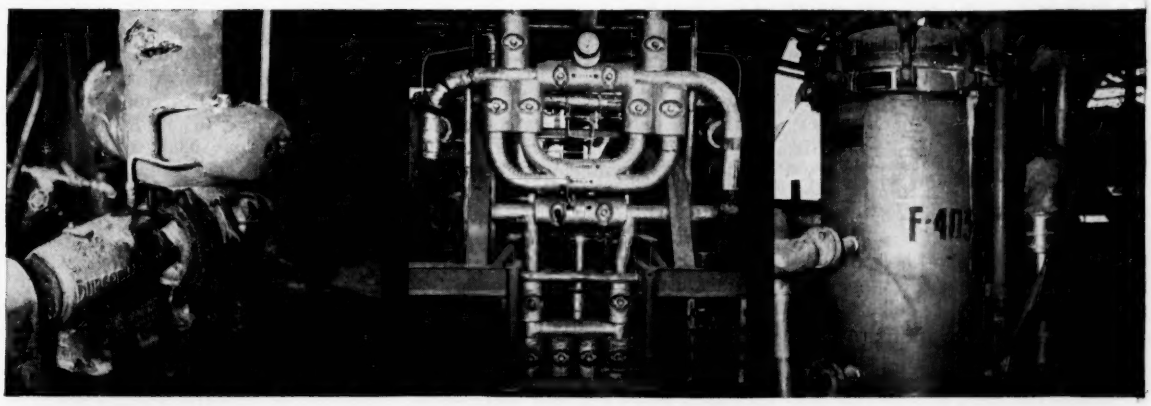
For handling tough corrosives in the production of urea

The Grand River Chemical Division of

DEERE & Company  uses DURCO pumps, valves, filters

Durco process equipment has been *the* answer to many of the severe corrosives handling problems at Deere & Company's Grand River Chemical Division. Durco Type F Valves, Series R Durcopumps, and Durco-Enzinger filtration equipment have smoothed the flow of urea by reducing down-time and lowering maintenance costs.

For more than a hundred years, John Deere has been serving America by supplying farmers with the finest of materials and equipment. For nearly fifty years, the Duriron Company has been building and supplying the very best of chemical service equipment.



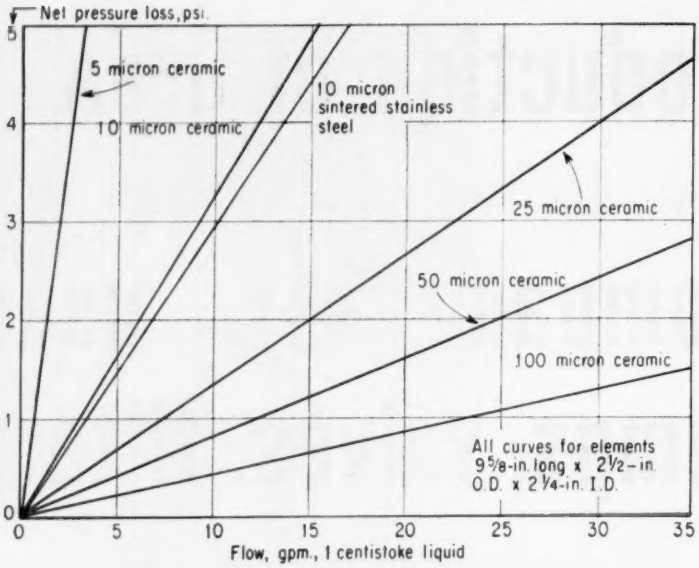
DURCO CORROSION RESISTING ALLOYS & EQUIPMENT

the mark of dependability in tough chemical service...everywhere

THE DURIRON COMPANY, INC., DAYTON, OHIO

Branch Offices: Baltimore, Boston, Buffalo, Chicago, Cleveland, Detroit, Houston, Knoxville, Los Angeles, New York, Pensacola, Philadelphia, and Pittsburgh

How Flow and Porosity Affect Pressure Drop



not considered ideal for filtration.

▶**Sharp Filtration** — But, according to Corning Glass, the new medium (to be used mainly in cartridge-type filters) can be produced with very closely controlled ranges of particle retentions. A ceramic filter unit, rated at 50 microns, will hold back 98% of all particles larger than 50 microns. Particles below 50 microns will pass through.

So here, apparently, is a medium which can handle very difficult materials, while making a sharp separation of solid from gas or solid from liquid. It is, in effect, a "go, no-go" process filter.

▶**Porous Metals**—Up until now porous metals were tops in this "tough" filtration field. Porous metals are made by sintering metallic powders of controlled particle size.[1] This gives a filtration element of a certain porosity and pore size. You can have almost any metal made porous: most grades of stainless, nickel, Monel, Inconel, Hastelloys, Durimet 20, silver gold, bronze. They come as plates, disks, tubes and convoluted forms. The metal elements can be bent into a number of simple contours.

There is no trick in making almost any pore size, but usually porous metal elements come in 4, 8, 12 and 25 microns. These are average, not specific ratings. The metals cover the range from low vacuum to 6,000 psi. and temperatures of −400 to 1,200 F.

In contrast to this, Corning doesn't make porous ceramics by a forming and sintering process. Instead the ceramic filter is "a discrete combination of very-high-temperature ceramics that determine its structure and reasonably high-temperature glasses that coat and bond them together." The ceramic is made in ratings ranging from 1 to 100 microns, each rating more specific than the porous metal rating.

Disks, tubes, plates are formed by mechanical pressing, hydrostatic pressing and extrusion methods.

▶**Who Makes Porous Materials?** —At present the important producers of porous metal filters are Cuno Engineering Corp., Meriden, Conn.; Purolator Products, Inc., Rahway, N. J.; Pall Industries, Glen Cove, N. Y.; Permanent Filter Corp., Los Angeles, Calif.

Producer of the porous ceramic filter is Corning Glass (and Commercial Filter Corp., Melrose, Mass. through license arrangement with Corning).

As the table on p. 158 shows, there are a number of porous metal techniques, besides straight forming and sintering, which offer ceramics competition.

Electrodeposits are a way of coating a filter element with a porous metal. Sintered fibers are also available and used as metal felt in filter cartridges. Another approach is the woven porous-metal sheet.

▶**Advantages, Disadvantages**— But each material has some advantages and disadvantages.

Take sloughing, for instance. This is shedding of filter particles. Electrodeposited metals and sintered powders have a tendency towards shedding. If it can be a severe problem from a contamination standpoint, sintered wire mesh or sintered fibers are your best bet.

Cleaning of this type of filter can be a problem. Fine particles eventually fill the interstices of the porous sections. And the material is too expensive to throw away. The usual procedure is to backwash the porous element. Thickness of the porous material is important here —a thin section can be easily cleaned, while backwashing a thick section may not remove all the trapped particles. Porous metals, to overcome this difficulty, are available in thicknesses of about 0.030 in. The ceramic tubes are usually ⅛-in. thick. Other techniques include soaking with acid to dissolve particles and, in the case of organic matter, the ceramic filters can be fired at 1,830 F. for about one hour.

▶**Porous Details** — The porous ceramic has a specific gravity of 1.95 and good strength: a modulus of rupture of 3,230 psi. at room temperature. This strength permits the material to operate under relatively high pressures and temperatures without cracking or disintegration.

It has a low coefficient of thermal expansion (3.5 x 10^{-6} in./

USCOLITE PLASTIC PIPE

*Commonwealth of Virginia, Hampton Roads Sanitation District Commission Treatment Plant at Foot of 44th St., Norfolk, Va.

Uscolite pipe solves an external corrosion problem for sanitation district

The Uscolite® pipe line installed in this treatment plant* carries 150 gallons a minute of a saturated chlorine water solution (actually treated sewage water) from the chlorinator to the main sewage line entering the plant.

Prior to installation of Uscolite, pipe severely corroded externally due to the chemical content of the soil and electrolytic action. *Uscolite has eliminated the costly maintenance and constant replacement of pipe.* Uscolite pipe was installed above and below ground because it is rigid enough to resist soil pressure, yet flexible enough to follow earth contours. UscoWeld† Fittings were installed in a fourth the usual time, saving many dollars. The welds are as strong and permanent as the pipe itself. Clamp-type fittings that leak, pull off and impair flow are never needed. *Not one foot of Uscolite Pipe has ever failed in service, when used in accordance with our recommendations.*

USCOLITE ELIMINATES COSTLY PIPE INSTALLATION

Superintendent of this plant says: "The simplest 'big' piping job we ever performed. Four men laid 1000 feet of 6" pipe per day without a sweat."

• • •

When you think of plastic pipe, think of your "U. S." Distributor. He's your best on-the-spot source of technical aid, quick delivery and quality industrial plastic products.

†Patent applied for

Mechanical Goods Division

United States Rubber

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

Rockefeller Center, New York 20, N.Y. In Canada: Dominion Rubber Company, Ltd.

Porous Ceramic Comes in Variety of Sizes **Table II**

	Wall Thickness, In.	Diameter In.	Length, In.
Tubing	1/8–1/4	7/8–4	36
Plates	1/16–1	Up to 12 (width)	Up to 22
Disks	1/16–1	1/2–12	

in./F.) and good resistance to thermal shock. Corning has taken the material from room temperature to 1,800 F. immediately without failure and dropped it down to room temperature from 1,800 F., also without failure.

As the curves on p. 160 show, flow characteristics of the ceramic are very similar to porous metals.

As for chemical resistance, the glass-bonded ceramic compositions are resistant to most acids (hydrofluoric acid and hot strong alkalis will attack porous ceramic.)

On cost, the new tailored ceramic is about the cheapest porous filtration material around. A 10-in. long by 2½-in. O.D. by 2¼-in. I.D. element cost about $16. A similar stainless steel unit would be about $32.

While ceramic disks, tubes and plates and cups are available, the major form in the process industries will be as tubes for cartridge filters—either the single- or multiple-tube type. Right now cylinders come in 10-in., 20-in. and 30-in. lengths, 2½ in. O.D. and 2¼-in. I.D.

The container shell poses a problem in severe corrosive work. A glass assembly is available as well as a metal shell. Both materials have their limitations and the metal-shell unit, presumably, will put some tough restrictions around the corrosion resistance limits of the total assembly.

However, plastic-lined shells are a possibility, and of course almost any metal can be used for the shell body.

► **Process Applications** — Usually a figure of 2% solids is quoted as the top limit for replaceable cartridge filters. Any liquid with a higher solids content would cut cartridge life down to an uneconomical point. However, the ceramic unit doesn't have to be replaced—you backwash it. So 2% solids may be somewhat low for porous metals and ceramics. But, it is a good order-of-magnitude figure.

Where can the porous ceramic be used? Most of the companies testing out this material are not willing to be quoted. Nevertheless, it is being used in concentrated hydrogen peroxide service, in the filtering of radioactive fluids (water, acids) and in catalyst recovery from catalytic cracking unit off-gas.

To round out the high-temperature-filtration picture, a promising new development has been National Carbon's graphite fiber.[4] This is not a porous fiber. But cloth made of the material should be useful in hot-gas filtration and for handling corrosive liquids. The mesh can stand up to an acetylene torch, and can also take low temperatures.

And Carborundum has offered Fiberfrax, an aluminum silicate fiber, since 1957.[2] The fibers, however, are not porous. Deep beds of these fibers are used in continuous exposures up to 1,500 F. Most applications have been in hot-gas filtration, primarily in atomic energy work. Efficiencies of up to 99% on 2 micron particles have been reported.[3]

And in this same area, you might consider porous plastics, which are available. Porous fluorocarbons and PVC have been around for some time as filtering media, and now porous polyethylene has been developed.

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1. Kovacs, J., *Materials in Design Eng.*, 47, Jan. 1958, p. 126-8.
2. *Chem. Week*, Aug. 17, 1957, p. 92.
3. First, M. W. and J. B. Graham, *Ind. Eng. Chem.*, Mar. 1959, p. 63A.
4. *Chem. Eng.*, May 4, 1959, p. 70.

Nickel-Lined Tanker Carries Strong NaOH

The first custom-built tanker designed for 73% caustic soda has met all design specifications. This comes from a drydock inspection of the S.S. Marine Dow-Chem (above), chartered by Dow Chemical.

The four nickel-lined caustic tanks (each with a capacity of 632,000 gal.) show no sign of caustic attack after three years' service. Tanker design called for nickel-clad plate and solid nickel heating coils, pumps, valves, piping.

The caustic is kept molten (230 F.) during the voyage. Nickel appears to have solved the dual problems of corrosion and iron contamination in the product.

Special welding techniques kept the iron content in the welds below 1%.

STRONG as steel pipe

...at one-eighth the weight!

Circumferential Tensile Strength... 80,000 psi

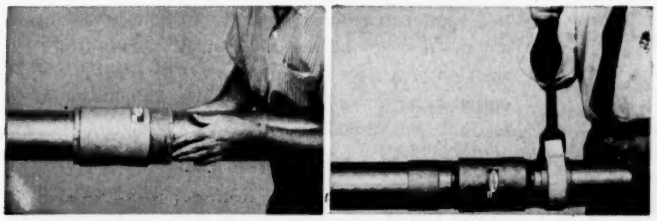
BONDSTRAND®

the revolutionary fiber glass reinforced epoxy pipe for corrosive service

114

Here's a pipe that holds up indefinitely under the corrosive action of many salt, acid and alkaline solutions... that can't contaminate or flavor the piped material... that is rigid enough to resist sag, cold flow or deformation – flexible enough to follow normal ditch contours... that remains smooth and unclogged throughout its entire service life... that won't leak, even near its burst pressure.

Easy to install, with choice of locking wedge or threaded fittings.



Simple instructions with each shipment insure a perfect joint on the first try.

IN THE CHEMICAL INDUSTRY...

This means that you can use BONDSTRAND to transport corrosive solutions, waste water, sewage, oils, foods, beverages and many other troublesome fluids. It's also ideal for ducting, conduit or handrails where corrosive atmospheres, condensation, spillage or immersion cause troubles with ordinary pipe.

Amercoat® CORPORATION

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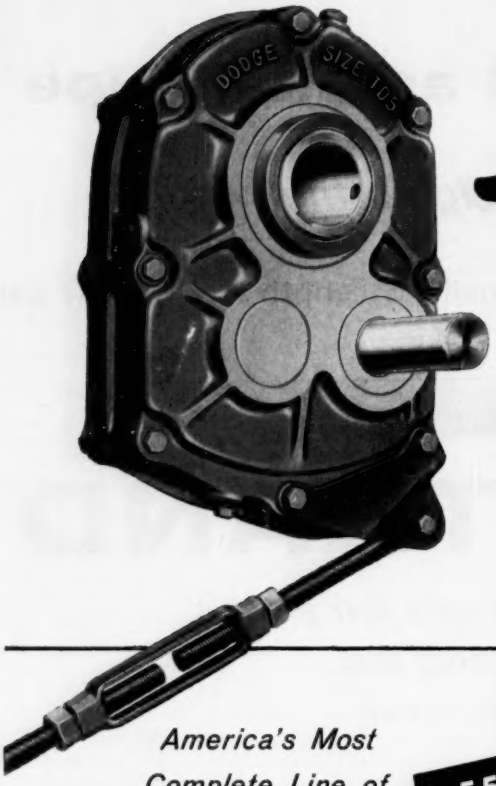
A Subsidiary of American Pipe & Construction Company



Torque-Arm

THE DODGE DEVELOPMENT THAT CHANGED THE NATION'S HABITS OF SPEED REDUCTION

America's Most Complete Line of Shaft Mounted Speed Reducers

55 MODELS

- Capacities up to 170 hp
- Output speeds from 10 to 378 rpm!
- Single Reduction
- Double Reduction
- 5 to 1 Ratio
- 15 to 1 Ratio
- 25 to 1 Ratio
- Any speed ratio up to 150 to 1 obtainable by selection of pre-determined combination of reducer and V-belt drive.

CALL THE TRANSMISSIONEER—your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look in the *white* pages of your telephone directory for "Dodge Transmissioneer."

In fewer than ten years, the range of Torque-Arm Shaft Mounted Speed Reducers has increased from 6 to 55 models, to meet the ever increasing demand for this improved method of speed reduction.

By eliminating foundation, sliding base and flexible coupling this modern speed reducer has saved untold installation time and untold dollars of cost.

The rugged semisteel housing developed by Dodge has never been improved upon. It is corrosion resistant—and it has the strength to hold bearing seats in line for the life of the unit.

Dodge design provides wide spacing for the bearings. Loads are carried easily, contributing to Torque-Arm's long life and very high efficiency. The gears are finest quality—helical, heat treated steel.

Torque-Arm mounts vertically or horizontally in any position around the driven shaft. It locks to the shaft on *both* sides of the housing. The holes in the output hub provide simple removal with puller. Overload release and built-in backstop are optional.

Dodge Torque-Arm is America's most widely used shaft mounted speed reducer. It is stocked by your local Dodge Distributor. Ask him. Or write us for bulletin.

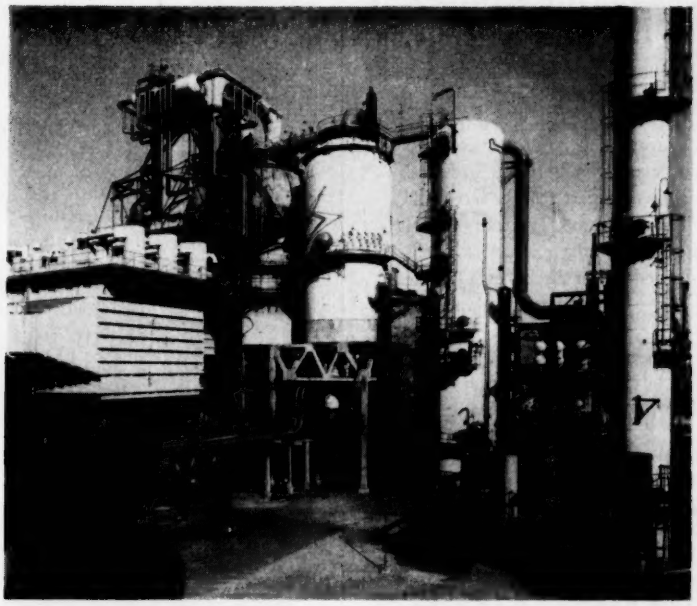
DODGE MANUFACTURING CORPORATION, 200 Union, Mishawaka, Ind.

DODGE
of Mishawaka, Ind.

FIRMS IN THE NEWS

J. A. KING

NEW FACILITIES



Petroleum Processing Medley Yields High Octane Fuels

Standard Oil Co. of Calif.'s new $33-million refinery at Richmond, Calif., just went on stream to produce high-octane fuels for today's high-compression engines. Keys to high octane at Richmond are the fluid catalytic cracking, butane isomerization and alkylation units. Giant 55,000-bbl./day cracking unit converts heavier petroleum stocks to light products, while the isomerization unit prepares isobutane feed for the gasoline-upgrading alkylation unit.

Continental Carbon Co. announces plans for a $2-million expansion of its Lake Charles, La., plant to increase its high-abrasive-carbon capacity from 45 to 70-million lb./yr. Fish Engineering Co. began construction last month, expects to complete the job by the end of this year.

Columbian Carbon Co. will soon begin construction of a 30,000-ton/yr. carbon-black plant near Milan, Italy. The $6-million plant will be operated by Columbian Carbon Europa, will supply carbon-black pigment and strengthening agent to European tire manufacturers.

Reichhold Chemicals Co. plans to construct a 20-million-lb./yr. melamine plant to be completed early in 1961. New facility is part of a $24-million expansion program, began last year.

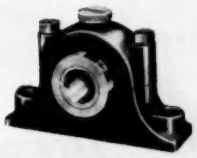
CIBA Products Corp. announces plans for the construction of an epichlorohydrin plant to be completed by June 1960 at Toms River, N. J. New plant will supply intermediate for the manufacture of epoxy resins at Toms River.

Diamond Alkali Co. began operation of its chlorine-caustic

DODGE PRODUCTS you should know

NEW! DYNA-V DRIVES
Save space, weight and cost!

TAPER-LOCK ROLLER CHAIN DRIVES
No reboring — no waiting!



DODGE PILLOW BLOCKS with TIMKEN BEARINGS
America's Quality Pillow Blocks!

Write for Bulletins!

- Dyna-V Drives—selection data.
- Chain and Sprockets—drive data.
- Rolling Bearings—ratings, data.

DODGE MANUFACTURING CORPORATION
200 Union Street • Mishawaka, Indiana

DODGE
of Mishawaka, Ind.

ADVANCED DESIGN
dreadnaught
ENCLOSED COUNTERSHAFT ENDS . . .
FOR SCREW CONVEYOR POWER TRANSMISSION

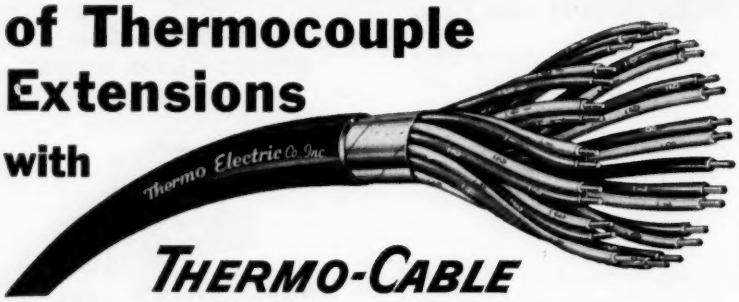
Stock units 6" to 20" screw conveyor with every possible shaft size. Each moving part readily accessible. Splash lubricated. Positive oil seals and rotating dust excluder. Thrust absorbed either direction. Operates horizontally or inclined.

● MADE IN 1:1 AND 2:1 RATIOS

SOUTHWESTERN
SUPPLY and MACHINE WORKS
OKLAHOMA CITY, OKLAHOMA

ESPECIALLY DESIGNED FOR THE TOUGHEST INSTALLATIONS

Reduce Installation Costs of Thermocouple Extensions with THERMO-CABLE



You can now install 6 to 56 pairs of thermocouple leads at one time with "Thermo-Cable," T-E's new multi-conductor extension cable. Installed in conduit, "Thermo-Cable" reduces costs by eliminating the need to pull individual conductors—and permits the use of smaller conduit for the same number of leads. "Thermo-Cable" can also be installed without conduit, in open troughs or in raceways.

"Thermo-Cable's" smooth, polyvinyl chloride outer jacket resists moisture, heat, abrasion and chemical action—and slips easily through conduit. ISA color coded, individual conductors are also insulated in hi-temp (221°F.) polyvinyl chloride—and the conductor bundle is wrapped in aluminum-backed Mylar tape for electrostatic shielding. Pairs are numbered alike and lie next to each other. "Thermo-Cable" is available in 6, 14, 18, 25, 39 or 56 pairs and comes in all standard thermocouple materials.

Write For Wire Section 33-E

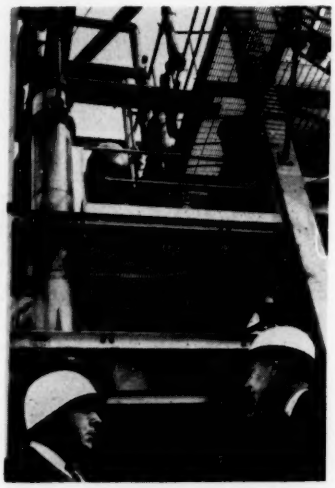
Thermo Electric CO., INC.
SADDLE BROOK, NEW JERSEY

In Canada:
THERMO ELECTRIC (Canada) LTD.,
Brampton, Ont.

FIRMS . . .

expansion at Deer Park, Tex. (*Chem. Eng.*, June 15, pp. 118-121). New facilities bring capacity up to 750 tons/day of chlorine, 825 tons/day of caustic soda and 7.5-million cu. ft. of hydrogen/day.

Mobay Chemical Co. has started construction of its polycarbonate resin plant at New Martinsville, W. Va., to be completed early next year. Mobay is employing process know-how, developed by its parent company, Farbenfabriken-Bayer, A. G.



Carrier Corp. executives view the water desalting pilot plant at Syracuse, N. Y., to be operated under contract to the Office of Saline Water. Pilot unit will make use of a direct-freezing process developed by Carrier, will begin operating next month.

Parke, Davis & Co. has begun construction of a two-story antibiotics-manufacturing plant at Holland, Mich. Expansion, to be completed by late next year, will increase Parke, Davis' capacity to produce chloromycetin and other antibiotics.

U. S. Atomic Energy Commission announces that construction is nearing completion of its plutonium-recycle test reactor at the Hanford Works. Reactor, costing $15-million, will be the first to be fueled

by plutonium recycled from the reprocessing of its own irradiated fuel elements.

American Marietta Co. has just dedicated this $1-million research laboratory for product development. New center provides facilities for 120 researching chemists, engineers and other personnel to develop phenolic, urea, resorcinal and epoxy resin products.

Argonne National Laboratory has begun constructing a 12.5-billion electron volt particle accelerator, called the Zero Gradient Synchrotron. Construction of the $29-million machine is scheduled for completion early in 1962.

Union Tank Car is building a 380-ft.-dia., 120-ft.-high dome to cover maintenance and tank car repair facilities at Wood River, Ill. Graver Tank & Mfg. Co., a div. of Union Tank Car, is designing and constructing the dome.

Tennessee Eastman Co., a div. of Eastman Kodak, announces plans for a new high-purity hydrogen plant at Kingsport, Tenn. Girdler will engineer and equip the plant to be completed early in 1960. Eastman will employ the steam-hydrocarbon process to produce 900,000 cu. ft. of hydrogen/day from natural gas for use in polyester fiber manufacture.

Monsanto Chemical Co. has completed its expansion of silica production facilities at its Everett, Mass., plant. Monsanto's Inorganic Chemicals Div. produces colloidal sus-

kill foam with a Dow Corning SILICONE DEFOAMER

Is foam giving you the old "one-two"? One—slowing up your processing . . . two—running up your costs? Fight back hard. Knock out foam fast, with Dow Corning silicone defoamers . . . most efficient foam killers known!

1 oz kills foam in:

3,125,000 lb cellulose slurry

62,500 lb hypo fix and film developer

6,250 lb acetic acid-wood alcohol distillation mix

FREE SAMPLE! Make your own test. Return coupon below for generous *trial sample* of a Dow Corning SILICONE DEFOAMER. No obligation, of course.

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Slurry Dewatering Problem?

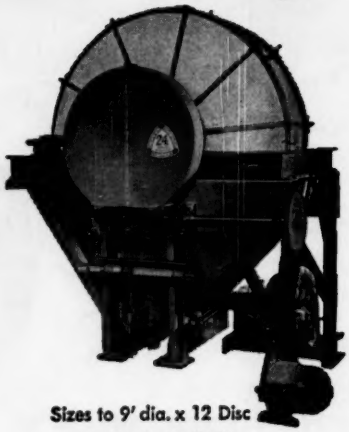
DENVER

AGITATOR-TYPE

DISC FILTERS

Exclusive diaphragm-activated agitating mechanism supplies proper pulp agitation. *No packing glands, no submerged bearings,* no possible contamination from grease or dilution from sealing water. Gives higher filter capacity, lower moisture content and more uniform, dryer filter cake—plus trouble-free, dependable operation.

DENVER Disc Filters without agitator mechanism, DENVER Packaged Filter Units and complete dewatering equipment also available. Laboratory Filtering Test Service at no charge.



Sizes to 9' dia. x 12 Disc

Write for Bulletin No. F9-B5

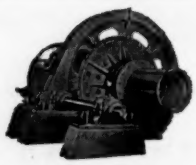
DENVER Equipment for the Chemical Process Industries

DENVER Adjustable Stroke Diaphragm Pumps
1" to 10" Simplex and Duplex, Capacity to 1000 g.p.m.

DENVER Spiral Rake Thickeners
Sizes to 150' diameter
Write for Bulletin No. T5-B6

DENVER Drum Filters
Sizes to 6' dia. x 8' long.
Write for Bulletin No. FG-B1

DENVER Dryers
Sizes to 8' x 60' and larger
Write for Bulletin No. D4-B4



DENVER Steel Head Mills
Sizes to 10' dia. x 20' long
Write for Bulletin No. B2-B20

DENVER Automatic Samplers
8" to 120" Cutter Travel
Write for Bulletin No. S1-B4

Specialists in Flotation Engineering

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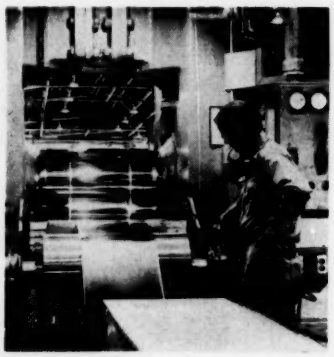
pensions of silica in water and silica aerogels.



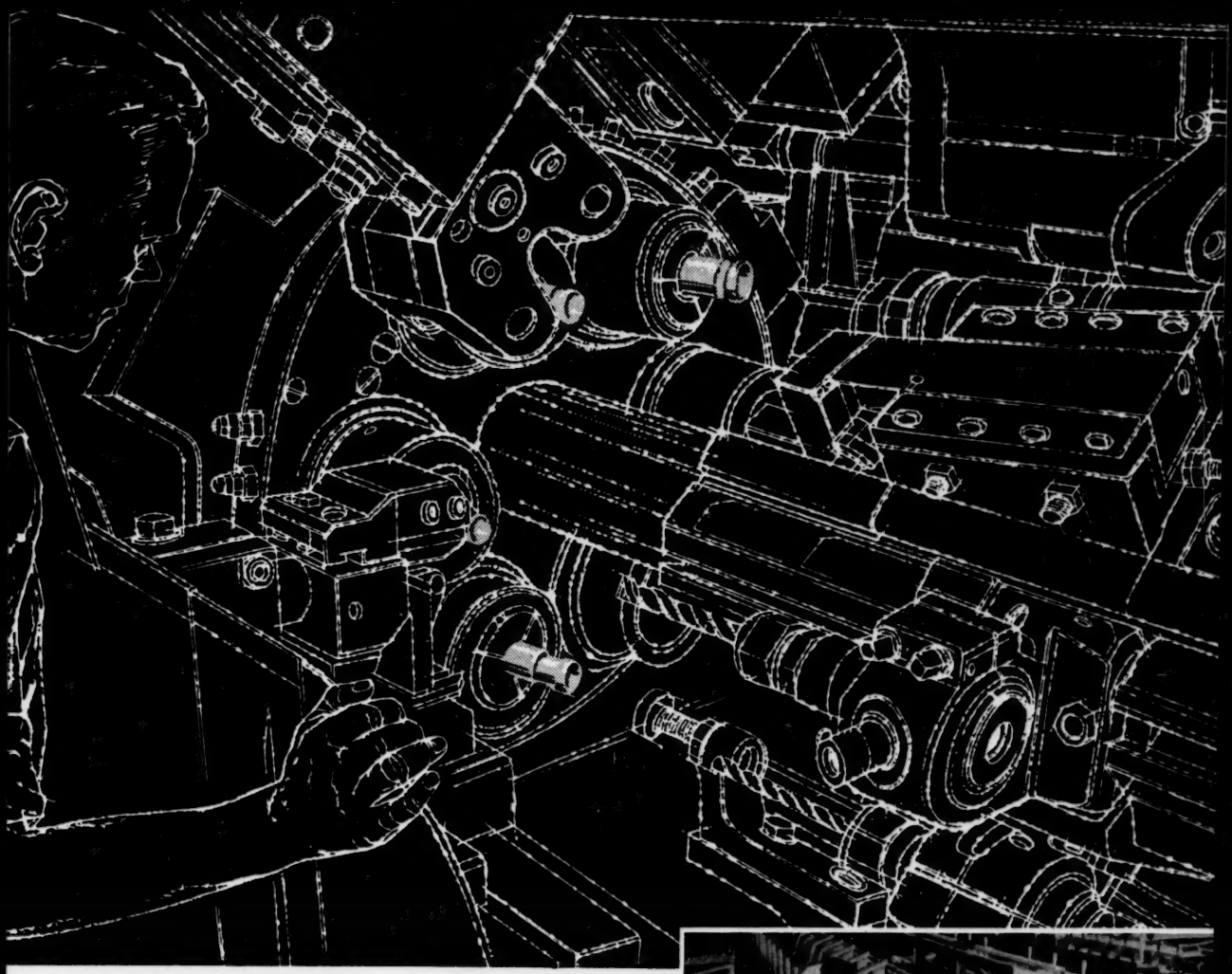
Universal-Cyclops Corp. announces the opening of its new 20,000-ton/yr. steel-strip plant at Coshocton, Ohio. Photo above shows new temper mill, used to assure hardness and luster of stainless-strip product.

Chicago Bridge & Iron Co. announces plans to expand its pickling facility for removal of mill scale from steel, at its Houston, Tex., plant. Expansion is part of a $1-million program started two years ago.

Aluminum Co. of America revealed plans to install a 5,200-ton extrusion press at its Vernon, Calif., works. New unit will enable Alcoa to extrude shapes up to 34-in.-sq. in cross-sectional area.

Koppers Co. has purchased Union Carbide Corp.'s Halowax plant at Wyandotte, Mich. Kopper's Tar Products Div. will operate the plant, will produce chlorinated paraffins, naphthalene and other chlorinated resins.

W. R. Grace has acquired the property and assets of Hatco



The Ultimate Test

The ultimate test of quality in stainless steel bars takes place in screw machine production, where every bar is literally cut to pieces.

The Perry-Fay Company, Elyria, Ohio, a leader in screw machine production, has been subjecting J&L bars to this demanding production-line test for more than a year, **without a single failure, without a single reject.** Perry-Fay reports: "We consistently get superior surface finish, closer tolerances, fully formed rolled threads with J&L stainless bars."

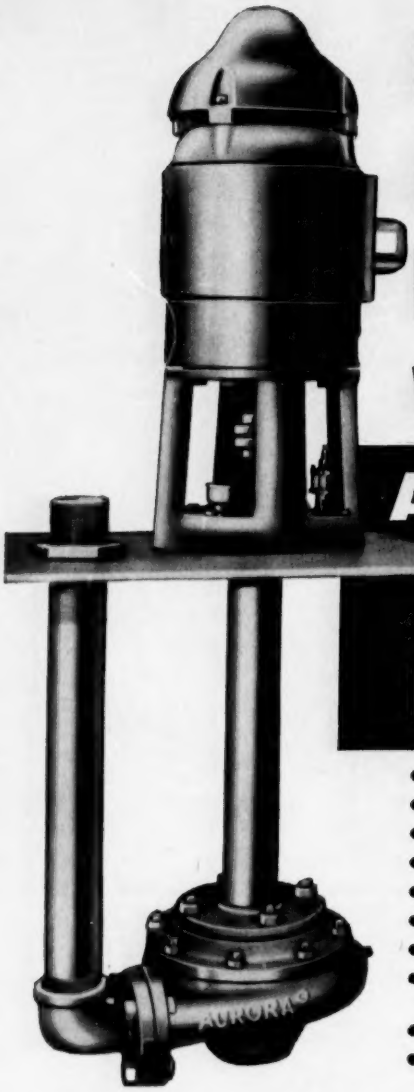
Whether you need stainless steel bar stock for high-speed, high-production operations, or a single bar for extraordinary requirements, turn to J&L. J&L leads the industry in melt shop standards for stainless steel, the point where quality starts—and new production profits begin.

Careful attention to every production detail is the key to J&L quality.

J&L
STAINLESS
SHEET • STRIP • BAR • WIRE

Plants and Service Centers:
Los Angeles • Kenilworth (N. J.) • Youngstown • Louisville (Ohio) • Indianapolis • Detroit

Jones & Laughlin Steel Corporation • STAINLESS and STRIP DIVISION • Box 4606, Detroit 34



Profit by Controlled Performance with...

AURORA® SUMP PUMPS

- PROVEN DEPENDABILITY
- APPLICATION ANALYSIS
- CALCULATED CAPACITIES
- SELECTED COMPONENTS
- HIGHEST QUALITY CONTROL
- RUGGED CONSTRUCTION
- MINIMIZED WEAR
- STANDARDIZED SERVICE FLEXIBILITY
- HEADS TO 170 FT.
- CAPACITIES TO 1500 G.P.M.

Ruggedness of construction and simplicity of design of AURORA pumps combine to provide longer life, highest efficiency, and minimized down time. This means more for "your pump operating dollar." Select from the "1001" types, sizes, and capacities of AURORA pumps to obtain *the one* specifically designed to fit your needs. AURORA sump type pumps are most frequently used for industrial wastes, industrial processing, boiler pit service, chemical transfer, corrosive liquid handling, pumping volatile liquids, washing services, and general purpose drainage.

WRITE TODAY FOR YOUR COPY OF BULLETIN 104

AURORA Always PUMPS

AURORA PUMP DIVISION
THE NEW YORK AIR BRAKE COMPANY
670 LOUCKS STREET • AURORA • ILLINOIS

LOCAL DISTRIBUTOR IS LISTED IN THE YELLOW PAGES OF YOUR PHONE BOOK

FIRMS . . .

Chemical Co. of Fords, N. J. Hatco Chemical produces phthalates, adipates, sebacates and other plasticizer materials.

Heyden Newport Chemical Co. announces the formation of a new company, Resinera del Tigre, for the production of gum rosin in Mexico. New company is jointly owned by Resinera, S. A. of Mexico and Heyden Newport.

National Starch and Chemical Corp. has purchased Polimeros, S. A., a producer of vinyl acetate polymers in Mexico City, Mexico. Vinyl acetate polymers are the base for latex paints.

Imperial Chemical Industries and Aluminum Co. of America announce the formation of a partnership to promote the growth of aluminum manufacture in the British Commonwealth.

Thompson-Ramo-Wooldridge has purchased a controlling interest in Magna Products, Inc., of Sante Fe Springs, Calif. Magna manufactures specialty chemicals and electronic instruments for the chemical industry.

Tremco Manufacturing Co. has just moved into this $1.5-million research center in Cleveland, Ohio. Tremco manufactures waterproofing agents for maintenance and construction.

Argentine Cement Co. announces a $3.6-million program to expand and modernize its plants in several provinces of Argentina. Allis-Chalmers is supplying the crushing, screening, compressor and

power generation equipment for the expansion.

Georgia-Pacific Paper Co. is expanding its pulp and paper manufacturing facilities at Toledo, Ohio, to increase its paper capacity from 350 to 600 tons/day. Hoffman Construction Co. will undertake the $10-15-million project.

OVERSEAS BRIEFS

West Germany's Deutsche Erdoel, A. G., of Hamburg plans to add an isobutylene plant to its Holstein refinery, to expand its production of petrochemical intermediates. Long-range plans include construction of consumer petrochemical products such as plastics.

Japan's Asahi Chemical has completed construction of a $9-million acryl-fiber plant at the base of Mt. Fuji in Fuji City. Asahi's Nobeoka plant is now producing about 4 tons/day of acryl fiber, tradenamed Cashmilon.

Canada: Sogemines Ltd. of Montreal has started construction of a $17-million nitrogen-chemicals plant at Maitland, Ont. New plant will produce ammonium nitrate, nitrogen solutions, anhydrous ammonia and hydrogen from Alberta natural gas.

Africa: Courtaulds, Ltd., and Colonial Development Corp. of England announce plans for the construction of a $28-million plant for the manufacture of unbleached sulfate pulp in the Union of South Africa. New plant, to be completed late in 1961, will produce up to 100,000 tons/yr. of unbleached pulp for the paper and board industries.

Poland: Standard Steel Corp. of Los Angeles, Calif., announces plans to construct a

CAMCO

Quality

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• ALLOY STEEL
• STAINLESS STEEL

FITTINGS

2000 Lb., 3000 Lb., 4000 Lb., and 6000 Lb.

SCREWED and SOCKETWELD

CAMCO also manufactures a complete line of 150 Lb. Stainless Steel Fittings.

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CAMCO FITTINGS, INC.
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THE *Quality* LINE IN FITTINGS

CAMCO

FITTINGS, INC. North Haven, Conn.

The valve for reciprocating pumps . . . old or new

Because they offer a happy combination of dependability, efficiency and extra life, DURABLA Valves are a credit to any reciprocating pump. Mechanically and metallurgically speaking, they will operate freely under temperature-pressure extremes, with highly corrosive fluids and in any position.

In a DURABLA Valve Unit, only "point contact" is made by the valve member on the sleeve, so it can't bind or hang-up. Due to its unique arched design, neither will it warp. The new V-7* taper-locked stud can be screwed down tight into the seat without any possibility of galling or breakage. And a self-locking nut and "drop-on" guard assure quick and easy inspection of working parts —without stud or seat removal.

Standard equipment on many new pumps, DURABLA Valve Units are also used throughout the world to re-valve older pumps. They come in fifteen sizes, designed to meet over 300 variations in installation requirements.

Write for new booklet CE-89

DURABLA MANUFACTURING COMPANY
114 Liberty Street, New York 6, New York

DURABLA®

DM-34

FIRMS . . .

$25-million fishmeal and oil plant behind the iron curtain. Fishmeal will be used as fertilizer, poultry and animal feed; oil will be used for leather tanning and paint and pharmaceutical manufacture.

India: National Rayon Corp. plans to construct a $3.8-million plant to manufacture transparent paper. National Rayon now produces caustic soda, sulfuric acid and rayon.

Roumania is planning to build a 45,000 ton/yr. synthetic rubber and a 33,000-ton/yr. polyvinyl chloride plant at Borzesti. Expansion includes startup of a 5,500-ton/yr. polyvinyl chloride plant at Turda and a 3,000-ton/yr. phenolic plant at Fagaras this year.

Africa: Societe Nationale Tunisiene de Cellulose is building an $11-million esparto pulp mill at Kasserine, Tunisia. New mill will treat esparto grass, convert it to high-quality, short-fiber pulp for paper making.

NEW LOCATIONS

Abbey Chemical Corp. announces plans to move its distribution, blending facilities and executive offices to Edison, N. J. Abbey will continue to operate its Springfield, N. J., sales offices and its Mercury Chemical Corp. sales offices.

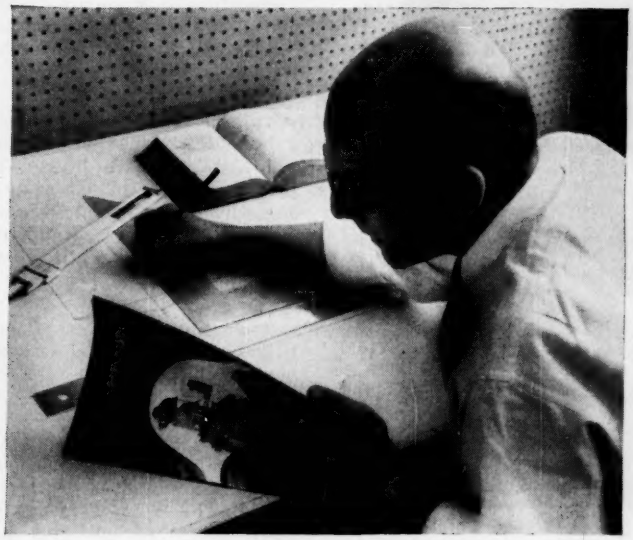
U. S. Borax Research Corp. plans to relocate its Anaheim engineering research department to its mining location at Boron, Calif.

Columbian Carbon Co. announces the opening of its Carbon Black and Pigment Div.'s research facility at Princeton, N. J. New headquarters of the research de-

FLUIDICS

is a new PFAUDLER PERMUTIT program that provides a modern, imaginative approach for handling and processing more profitably the liquids and gases involved in such operations as:

corrosioneering
water treatment
waste treatment
reactions
ion exchange
blending
metering
storing
heat transfer
centrifuging
fluid analysis
flow rate control



FLUIDICS AT WORK

New E Series Reactors incorporate many improvements

The many improvements in materials and designs listed here are now standard on the Pfaudler E Series Clamped-Top Reactor which runs from 50 to 2000-gallon capacity.

Glasteel 59 construction. All E Series Reactors are now made with Glasteel 59. This has all the corrosion resistance of previous Glasteels . . . practically unlimited resistance to all acids except hydrofluoric at temperatures up to 350 F. and to most alkalies at mild temperatures. And you also get 30% greater thermal shock resistance than with other glassed-steel constructions along with a 20% increase in abrasion resistance.

New Drives. On smaller sizes you get the new "W" Drive, a worm gear drive for either fixed or variable speed performance. Available with V-belt primary reduction or enclosed double reduction gearing. Hydraulic model available for explosion-proof operation or where wide variable speed range is desired.

On the 1000 to 2000-gallon sizes, our new BH Drive is now standard. This new bevel gear drive has many refinements which cut operating and maintenance expenses by as much as 50%. Among the refinements are a higher critical agitation speed and a wider bearing spread.

Seals or stuffing boxes are available for both drives.

New accessories. New, one-piece, all-glassed interior flush valve. New, glassed ductile-iron pipe fittings. Jacket agitating nozzles and thermowells.

The complete story on the E Series Reactors and accessories is told succinctly in Bulletin 971.

FLUIDICS AND THE WONDER METALS

Free samples of titanium, tantalum and zirconium

Here's your chance to get samples for your own preliminary in-plant testing of titanium, tantalum, and zirconium.

To demonstrate the thoroughness of our FLUIDICS program in seeking out and using all possible materials of construction, we are offering a series of three corrosion-resistant coins.

Each is a sample about the size of a half-dollar of one of the metals mentioned.

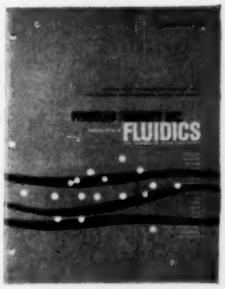
A handy brochure accompanying each sample coin spells out the metal's particular virtues and possible areas of application, as well as Pfaudler's new abilities in fabricating.

We've already had considerable experience with all three metals, experience which has enabled us to fabricate production size equipment from them.

To get the samples, just send us your name, company address, and title on your business letterhead. Supplies are limited.

FLUIDICS AT WORK

Fluidics Buyer's Guide Now Available



Here is your ready reference to the equipment and engineering services encompassed by the FLUIDICS program. It offers you a single source of supply —a single point of responsibility for solving your problems involving fluids.

You can quickly find the various equipment specifications and materials available for the operations of corrosioneering, water treatment, ion exchange, reactions, evaporation, distillation, drying-blending, centrifuging, heat transfer, filling, storing, agitating, valving and piping, gas analysis and control, waste treatment, and project engineering.

For your copy, write for Bulletin No. 980.

FLUIDICS AROUND THE WORLD

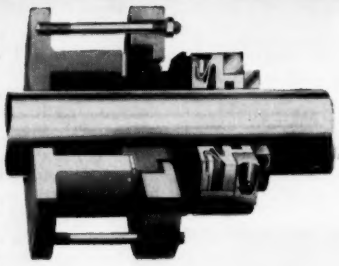
Pfaudler Permutit is a world-wide company with plants in: Germany, Great Britain, Canada, Mexico, Japan; as well as four plants in the U. S. A.

For additional information, write our Pfaudler Division, Dept. CE-89, Rochester 3, New York.

PFAUDLER PERMUTIT INC.

SPECIALISTS IN FLUIDICS . . . THE SCIENCE OF FLUID PROCESSES

LAST LONGER IN CORROSIVE CHEMICALS



Garlock Chemiseal® Mechanical Seals possess greater immunity to corrosion and are more economical than any other design offered. This reputation is based on fact—customers report unsurpassed performance on applications like these:

- **Pumping HYDROXYACETIC AND SULFURIC ACID**
  1750 rpm, 1½" shaft. 10 lbs. suction, 60 lbs. discharge. Temperature of medium 30° C. RESULT: Chemiseal greatly extended service life.
- **HIGHLY ABRASIVE SERVICE (ESTER—10% SOLIDS SLURRY)**
  3600 rpm. 625 lbs. discharge, 30 lbs. suction. Stuffing box pressures 15 lbs. to 65 lbs. Temperature of medium 70° C. RESULT: Chemiseal gave longer, leak-proof operation.
- **Pumping CONCENTRATED SULFURIC ACID**
  1750 rpm. 1 3/16" shaft. 2 lbs. suction. 45 lbs. discharge. Temperature of medium 65° C. RESULT: Chemiseal gave longer life.
- **Pumping ADIPIC ACID AND HYDROCARBON SLURRY**
  1750 rpm. 1⅛" shaft. 35 lbs. suction, 75 lbs. discharge. Temperature of medium 70° C. RESULT: Chemiseal lasted longer, cut downtime.

Join the list of satisfied users. You can apply standard Garlock Chemiseal Mechanical Seals to all pump shafts from ⅛" to 2⅛". Special sizes also available. They seal against all mediums—including solids in suspension—in pressures to 100 psi at 75° C, or 75 psi at 100° C. Chemiseal Mechanical Seals are another of the Garlock 2,000 . . . two thousand different types of gaskets, packings, and seals for every need. Find out complete details by contacting your local Garlock representative, or write for Catalog AD-164.

THE GARLOCK PACKING COMPANY, Palmyra, N. Y.

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Molded and Extruded Rubber, Plastic Products

Canadian Div.—The Garlock Packing Co. of Canada Ltd. • Plastics Div.—United States Gasket Co.

FIRMS . . .

partment will focus its efforts on pigment research and development.

Technical Measurement Corp., manufacturer of radiation-measuring instruments, just moved its entire operation into a new plant in North Haven, Conn.

General Electric Co.'s Atomic Products Div. has moved to Palo Alto, Calif., to be closer to three other of GE's nuclear divisions: Atomic Power Equipment Dept., Hanford Works and Idaho Falls Test Station.

Daystrom Weston Sales Div. has opened two sales and service offices, one in Seattle, Wash., and another in New Orleans, La.

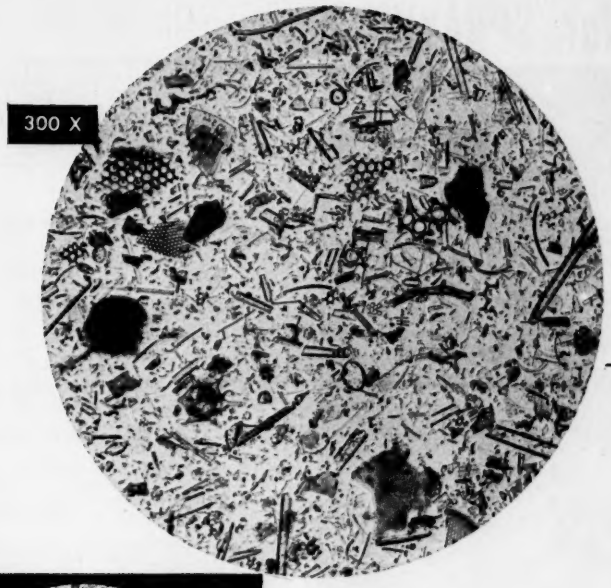
Pulp Chemicals Association has opened new offices in New York. The PCA, formed in 1947, publishes bulletins on the technology of tall-oil products and sulfate turpentine.

Stone & Webster has opened an office at Amsterdam, Netherlands, to meet European demand for petrochemical-plant design.

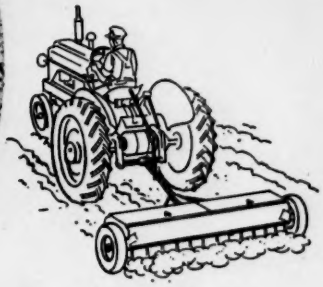
NEW LINES

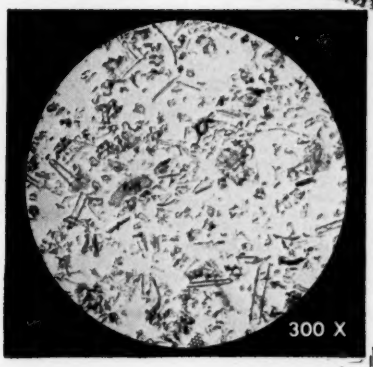
Vanton Pump Div. of Cooper Alloy Corp. announces formation of Design Service Dept. to solve fluid-handling and pump problems. New department will offer technical services to pump purchasers and users.

General Mills and Savage & Parsons, Ltd., are breaking into the nuclear industry, have formed Nuclear Equipment, Ltd., to design, manufacture and market remote-control handling equipment for hot laboratories.

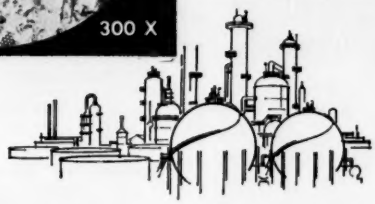


For fertilizer coating—Celite 379, a natural milled diatomite, provides the uniform conditioning needed to prevent caking of granular, mixed or prilled fertilizers—maintains good free-flow characteristics even after prolonged storage.

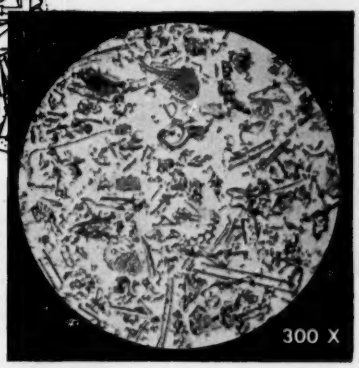




For catalyst carriers—Super Floss, finest particle size flux-calcined Celite grade, is used where a non-reactive porous silica support is needed. (Also available: special Celite supports in many preformed shapes for strength, high temperature stability, resistance to abrasion and attrition.)



As a paint-flatting agent—Celite 281, air-floated fines of flux-calcined diatomite, provides uniform and efficient flatting at low cost. Contributes to control of low angular sheen, durability, and faster drying.



In diatomites, Johns-Manville precision processing works for you

Celite diatomite absorbs its own weight of liquid . . . yet stays 'dry'

No matter which of the many available grades you choose, you can depend on a given volume of inert Celite* to retain its typical dry-powder characteristics even after absorbing its own weight of liquid.

Actually, Celite can absorb a total of more than twice its own weight. That's because a mass of the fine skeletal particles is approximately 93% air space or voids. Yet, in spite of this very high porosity, Celite is essentially non-hygroscopic.

Other unique properties—extremely high bulk, irregular particle shape and large available surface area—ideally suit Celite to hundreds of mineral filler applications. It is produced with precision from the world's purest commercially available diatomite deposit. It offers a wide choice of grades, each carefully controlled for complete uniformity.

For technical data on specific mineral filler or filtration problems, talk to your nearby Celite engineer. Or write to Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

*Celite is Johns-Manville's registered trademark for its diatomaceous silica products

JOHNS-MANVILLE

JOHNS-MANVILLE JM PRODUCTS

What are you paying for SPRAYING?

EXAMPLE:
Spraco Full-Cone Free-Flow Nozzles — for high capacity, low pressure installations

Spraco full-cone, free-flow nozzle discharging 860 gpm at 5 psi. At this shutter speed (1/5,000 sec.) pump pulsations are apparent in the spray pattern

To answer a long felt processing need, Spraco recently developed a totally new line of full-cone, free-flow nozzles for high capacity, low pressure installations where clogging is a problem and a full-cone spray a necessity. Featuring streamlined internal vane construction with maximum vane openings, they offer minimal flow resistance, virtually eliminate clogging.

Now widely used in cooling towers, coke quenching, aerating and purifying water supplies, and a host of chemical processing applications, Spraco Full-Cone Free-Flow nozzles are another excellent example of how Spraco cuts the cost of spraying by increasing the efficiency of the system.

What's your spray nozzle problem? Spraco offers the most complete range of nozzle sizes and capacities available anywhere, always in stock, and made from bronze, cast iron, stainless steel, or, to order, from any special machineable material.

Write today for the most comprehensive spray nozzle catalog ever published. Complete, accurate performance data for each of the hundreds of spray nozzles in the line.

SPRAY ENGINEERING COMPANY, *115 Cambridge Street, Burlington, Mass.*

SPRACO

CALENDAR

International Union of Pure an Applied Chemistry, symposium: Chemical Thermodynamics.
Aug. 20-25 Wattens, Austria

American Rocket Society, symposium: Gas Dynamics, Northwestern University.
Aug. 24-26 Evanston, Ill.

Gordon Research Conference: Instrumentation, Colby Junior College.
Aug. 24-28 New London, N. H

Combustion Institute, 8th International Symposium on Combustion, California Institute of Technology.
Aug. 29-Sept. 2 Pasadena, Calif.

Chemical Institute of Canada, Physical Chemistry Div. meeting, McMaster University.
Aug. 30-Sept. 1 Hamilton, Ont.

International Union of Pure and Applied Chemistry, symposium: Chemical Thermodynamics.
Aug. 30-Sept. 6 Munich, Germany

American Society of Mechanical Engineers, International Air-Pollution Congress, Statler-Hilton Hotel.
Sept. 10-11 New York, N. Y.

Society of Plastics Industry, midwest conference.
Sept. 10-11 New York, N. Y.

Armed Forces Chemical Assn., annual meeting, Statler Hotel.
Sept. 10-11 New York, N. Y.

Technical Assn. of the Pulp and Paper Industry, 14th Paper-Plastics Conference, Edgewater Beach Hotel.
Sept. 21-23 Chicago, Ill.

Instrument Society of America, 14th annual Instrumentation-Automation Conference and Exhibit, Amphitheatre.
Sept. 21-25 Chicago, Ill.

Industrial Nuclear Technology Conference, Morrison Hotel.
Sept. 22-24 Chicago, Ill.

American Rocket Society, conference on solid propellants, Princeton University.
Sept. 24-25 Princeton, N. J.

American Society for Quality Control, Chemical Div., annual conference, Shamrock Hilton Hotel.
Sept. 24-25 Houston, Tex.

International Union of Pure and Applied Chemistry, 20th conference.
Sept. 26-29 Munich, Germany

American Institute of Chemical Engineers, national meeting, Hotel St. Paul.
Sept. 27-30 St. Paul, Minn.

American Oil Chemists Society, fall meeting, Statler Hotel.
Sept. 28-30 Los Angeles, Calif.

American Institute of Mining, Metallurgical and Petroleum Engineers, Div. of Petroleum Engineers, fall meeting.
Oct. 4-7 Dallas, Tex.

American Gas Assn., national conference, Conrad-Hilton Hotel.
Oct. 5-7 Chicago, Ill.

International Symposium on High-Temperature Technology, arranged by Stanford Research Institute.
Oct. 6-9 Asilomar, Calif.

Society of Plastics Engineers, Technical meeting: Vinyl Plastics.
Oct. 7 Cleveland, Ohio

American Vacuum Society, annual meeting, Penn Sheraton Hotel.
Oct. 7-9 Philadelphia, Pa.

Assn. of Agricultural Chemists, annual meeting, Shoreham Hotel.
Oct. 12-14 Washington, D. C.

Technical Assn. of the Pulp and Paper Industry, engineering conference, Penn Sheraton Hotel.
Oct. 12-15 Pittsburgh, Pa.

Western Agricultural Chemicals Assn., fall meeting, Villa Hotel.
Oct. 13-14 San Mateo, Calif.

Society of Plastics Engineers, technical conference, Ambassador Hotel.
Oct. 13-14 Los Angeles, Calif.

Natural Gasoline Assn. of America, southern meeting, Carlton Hotel.
Oct. 16 Tyler, Tex.

American Production and Inventory Control Society, annual technical conference and exhibit, Hotel New Yorker.
Oct. 16-17 New York, N. Y.

International Fair of the Plastics Industry, Europe Hall.
Oct. 17-25 Dusseldorf, Germany

American Coke & Coal Chemicals Inst., annual meeting, Greenbrier.
Oct. 19-20 White Sulphur Spa., W. Va.

American Standards Assn., national conference, Sheraton-Cadillac Hotel.
Oct. 20-22 Detroit, Mich.

National Agricultural Chemicals Assn., national meeting, Sheraton Lick Hotel.
Oct. 21-23 French Lick, Ind.

National Lubricating Grease Institute, annual meeting, Roosevelt Hotel.
Oct. 26-28 New Orleans, La.

Independent Petroleum Assn. of America, annual meeting, Statler-Hilton Hotel.
Oct. 26-27 Dallas, Tex.

American Institute of Chemical Engineers, New York Section, annual symposium, New Yorker Hotel.
Oct. 27 New York, N. Y.

Canadian Chemical Specialties Manufacturers Assn., annual meeting and convention, Royal York Hotel.
Nov. 2-4 Washington, D. C.

American Society for Metals, annual exposition and congress, International Amphitheatre.
Nov. 2-6 Chicago, Ill.

American Nuclear Society, national meeting, Sheraton Park Hotel.
Nov. 4-6 Washington, D. C.

Technical Assn. of the Pulp and Paper Industry, Alkaline Paper Conference, Robert Meyer Hotel.
Nov. 4-6 Jacksonville, Fla.

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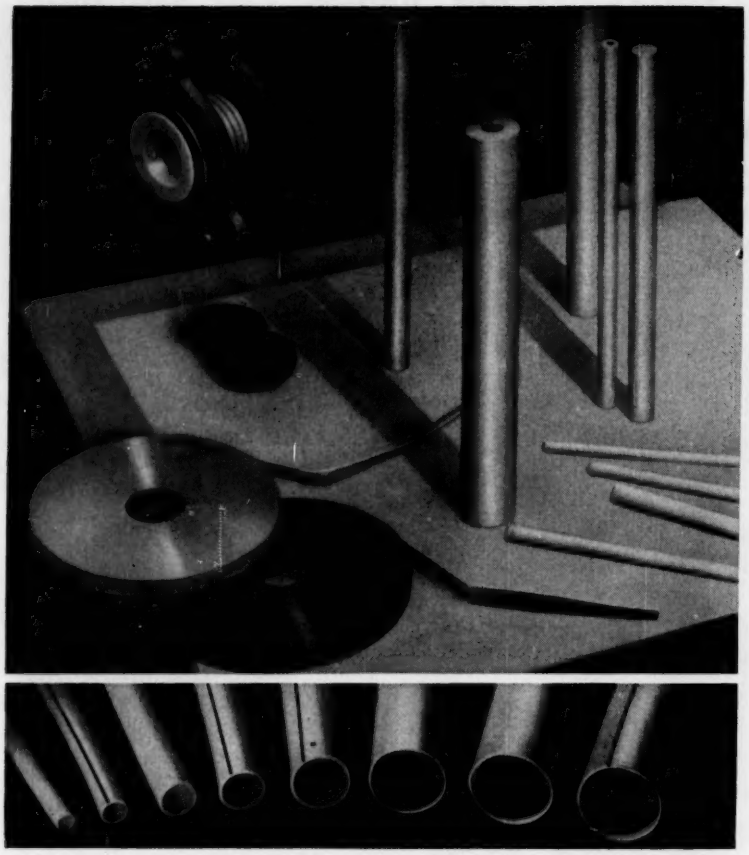

A fraction of R/M's extensive line of "Teflon" products. *(upper)* New "Teflon" expansion joint has square convolutions for extra strength. Other products include sheets, tubes, rods, tape and bondable "Teflon." *(lower)* Thin-wall tubing is now available with or without color striping.

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Need 1/32-in.-thick "Teflon" in 36 x 36 in. sheets . . . 48 x 48 in. sheets of greater thicknesses? Or custom fabricated "Teflon" parts made to your exact design requirements? Whatever your "Teflon" needs may be, R/M's complete service—a broad range of sizes, plus ample facilities for extruding, molding or machining special pieces, precisely to your specifications—means faster, simpler meeting of your "Teflon" requirements—and assurance of complete satisfaction.

In addition, you can benefit from R/M's extensive research and development in the use of "Teflon." Competent R/M sales engineers are always available to assist you in making full use of its many unique properties.

For full information about R/M "Teflon" expansion joints, tubes, thin-wall tubing, rods, sheets, tape, bondable "Teflon," and "Teflon" parts, contact your nearest R/M district office. Or write for detailed literature.

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(*Continued from p.* 94)

of the unit, adjusts for bag width, a rear handwheel for bag length. Bag sizes can start at 50 lb.—**Bemis Bro. Bag Co., St. Louis, Mo.** 94D

Torsion Balance

Ends trial-and-error procedures during weighing.

Personnel can weigh samples in one-third of usual time with the new Dial balance, say company officials. A simple, graduated dial, which can be turned without arresting the oil-damp balance, replaces time-consuming "cut-and-try" procedures necessary with the graduated-beam plus slide weights of conventional balances.

Graduated from 0 to 10 g. by 0.1-g. markings, the dial is readable to 0.02 g. Oil-damping minimizes oscillation to facilitate the weighing operation. Maximum capacity is 500 g.—**The Torsion Balance Co., Clifton, N. J.** 178A

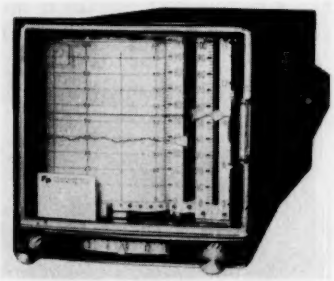
Oxygen Analyzer

Measures the paramagnetic properties of sample.

Designated Model 632, a new oxygen analyzer is offered for three low concentration ranges: 0 to 1%, 0 to 2% and 0 to 3%. The instrument is not affected by H_2 concentrations up to 50%, is sensitive to changes as low as 0.01% O_2, and is accurate to $\pm 2\%$.

Analyzer construction incorporates a basic Wheatstone-bridge resistance circuit within a recorder to provide a con-

tinuous record of oxygen content by measurement of variations in the paramagnetic properties of the sample gas. When coupled with the company's Universal recorder and a suitable sampling system, the new device provides response time constants of 4 to 7 sec. There are no moving parts to wear out or break down.—**Hays Corp., Michigan City, Ind. 178B**



Strip-Chart Recorder

Ink supply lasts a month without refilling.

Improved 4-in. strip-chart recorder and recorder-controller feature a modified inking system that provides a full month's record without refill. Re-inking can be accomplished without interfering with movement of pen parts.

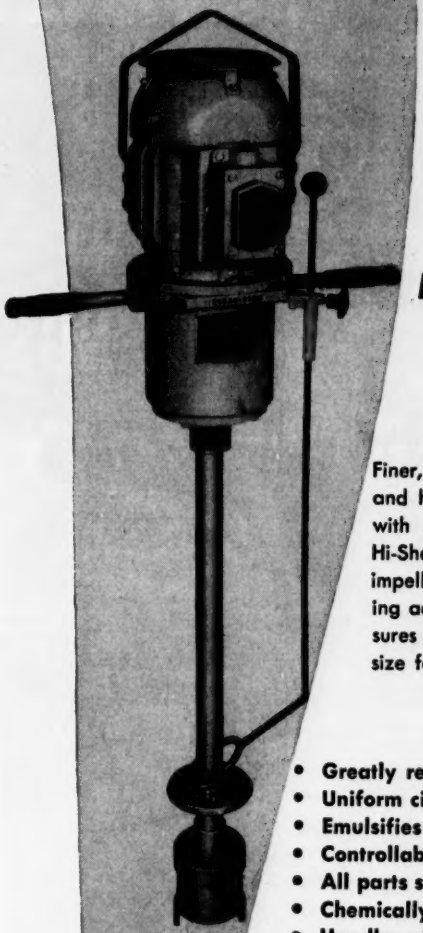
In addition to the new inking system, the Mark III recorder-controller has a flip switch for reversing controller action from air-to-open to air-to-close. Other new features of the instruments include wide-visibility plastic door, built-in damping of pneumatic input signals, fused chart motor and easier-to-read scales with larger high-intensity colored pointers.—**Fischer & Porter Co., Hatboro, Pa. 179A**

Metering Pump

Air-operated unit slug feeds viscous liquids.

Airmatic's VC 1000-1 positive-displacement pumps are specifically designed for slug feeding of precise quantities of slurries, pastes and viscous liquids. The units are infinitely

SHEAR-FLOW



the modern mixer with power shearing

Finer, faster blending, dispersing and homogenizing is now possible with Shear-Flow's new Model RL Hi-Shear Head. Finely spaced dual impellers induce considerable shearing action and high pumping pressures that rapidly reduce particle size for superior material mixtures.

- Greatly reduces mixing time
- Uniform circulation—no vortex
- Emulsifies immiscible liquids
- Controllable flow pattern
- All parts stainless steel
- Chemically inert seals
- Handles viscous materials with ease
- No operating Torque
- Disperses, blends, homogenizes

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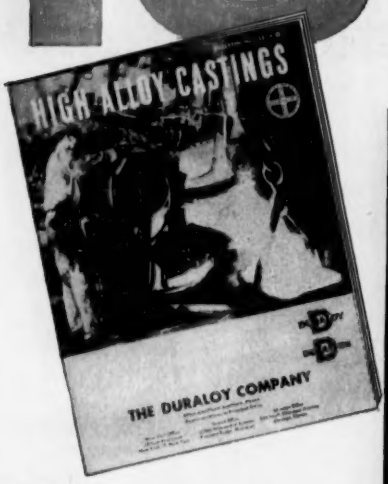
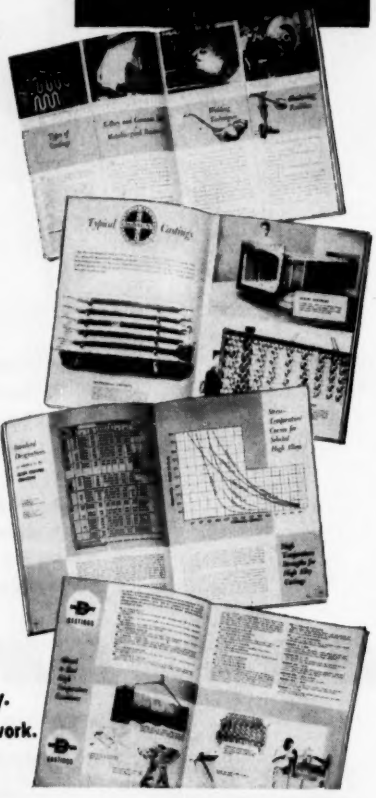


HIGH ALLOY CASTINGS

DURALOY DURASPUN



This is our New General Bulletin—3354G. It's full of information and data on the chrome-iron and chrome-nickel castings so necessary when corrosion, high temperatures and abrasion must be resisted. It will serve as a general selection guide for those specifying or using such castings.

The bulletin also reviews briefly our experience in both static and centrifugal castings, an experience going back to the pioneering days of 1922 and 1933 respectively. It also tells about our facilities for furnishing castings to any desired analysis, welding, X-ray and gamma ray testing, metallurgical and foundry control.

WRITE or CALL our nearest office for a copy.
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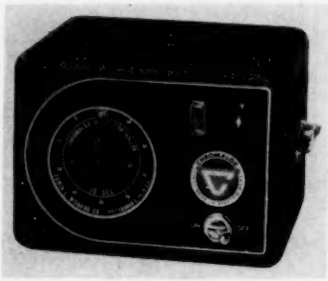
adjustable within the capacity range of 0 to 6.44 cc.

Each pump consists of a solenoid-actuated pneumatic cylinder and a pumping head. The pumping head contains inlet and outlet ports and provisions for precise limitations of stroke length of the air-cylinder piston. Check valves are not integral; they may be placed in the inlet and outlet lines if necessary. Maximum inlet air pressure is 200 psi.—**Airmatic Valve, Cleveland, Ohio. 179B**



Input Controller

Regulates electrical input to heating loads.

New Chromalox input controllers, Type VCP, are packaged master control panels for governing electric input to heating loads where the mass of components and the heating system are relatively large. Instrument rating is 15 amp. at 115 or 230 v.

Each factory-wired unit comes in a surface-mounting, drawn-steel box with hinged cover. Other components include a fused disconnect switch, indicating light for line and load, and a built-in terminal block. Single-phase loads over 15 amp. and three-phase loads require a contactor.—**Edwin L. Wiegand Co., Pittsburgh, Pa. 180A**

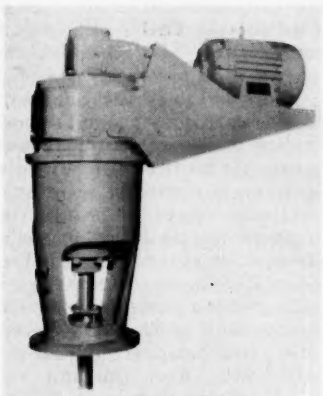
Filter Medium

Composed of staple yarns and synthetic filaments.

Combination fabrics for filtration are now out of the development stage. Through the use of continuous filament yarn

in the warp, of such synthetics as linear polyethylene and PVC, together with such spun or staple filling yarns as Dynel and Orlon, the manufacturer has achieved combination fabrics that have proved ideal for tough applications.

Such a combination takes advantage of the high strength of plied continuous filament warp yarns, and joins this with the cover and retentivity afforded by the spun or staple yarn in the filling direction. Net result gives improved cake discharge and greater abrasion resistance, along with the chemical resistance from the fibers themselves. Test samples are available.—**National Filter Media Corp., New Haven, Conn.** **180B**



Turbine Agitators

Modular components combine to meet requirements.

A line of turbine agitators, dubbed Moduflex, derives great flexibility to meet a wide variety of process requirements from an inventory of modular components. Five basic gear-drive configurations are available in sizes through 75 hp.: right-angle head, belt-driven, in-line with coupled motor, in-line with integral motor and variable speed. Each configuration comes in seven basic case sizes, with a choice of any AGMA gear ratio and a selection of three mountings for open and closed tanks.

In addition to choice of material for wetted parts, three

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Most stable of the green pigments. Unaffected by acids, alkalis, vehicles, and solvents. Non-fading.

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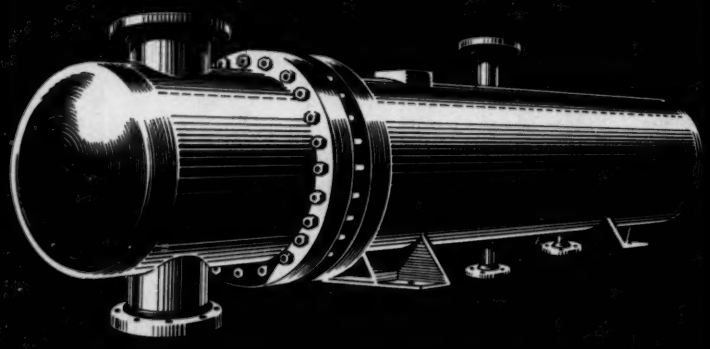

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Today's rapid strides in the technology of processing plant operation make it essential for a manufacturer of equipment to be "staffed up" with people who have had extensive training and experience. More than half our staff have spent a major part of their working life in this one field and have played a major role in the design and fabrication of many types of processing equipment. They know the limitations and workability of all metals and how to get maximum service from each. This accumulated knowledge of base materials and our extensive experience in design and fabrication means practical, trouble-free equipment at the lowest possible cost.

It is impossible, in a field requiring such wide diversification, to illustrate, or even list, all the products we have been called upon to supply. The chiller above is simply one among thousands.

Call on us the next time you need equipment. We are fully qualified to design and fabricate to all codes.

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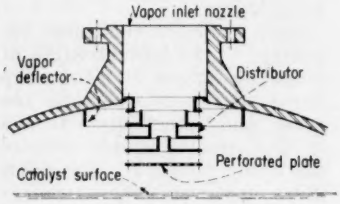
standard impeller styles are offered: straight blade, curved blade and the 45-deg. pitched blade.—**Chemineer, Inc., Dayton, Ohio.** **181A**



Inlet Distributor

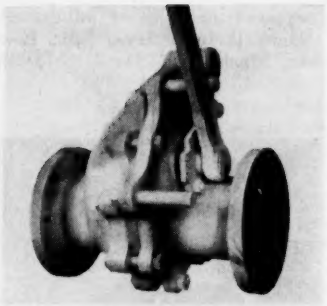
Stops plugging in fixed-bed reformers.

When high-velocity vapors entering a fixed-bed, platinum reforming unit impinge directly on the catalyst, the catalyst tends to move to outer edges of the vessel. This can generate fines which plug the bed and give a high pressure drop.

Designed to correct such conditions, Socony Mobil's new vapor inlet distributor is now available for licensing. The distributor minimizes high-velocity eddies on top of the bed. It also reduces the need for additional free vapor space above the bed. Actually, vapors enter the reactor with a horizontal velocity component above and toward the outer periphery of the catalyst bed. Also, the unit acts to distribute the vapors in proportion to the catalyst surface.

In operation, the unit discharges about 60% of inlet vapor from two rings at the top. In this manner, much of the inlet vapor must travel a long distance before entering the bed. These upper streams are further slowed by a deflector ring.

Vapors from lower rings enter at a lower velocity and, as a result, may be discharged directly into the reactor without impinging against a deflector plate. Perforations in the bottom plate pass about 10% of inlet vapors. This small stream counterbalances any inward flow of vapors along the catalyst's surface, and improves vapor distribution. — **Socony Mobil Oil Co., Inc., New York, N. Y.** **182A**



Slurry Gate Valves

Interior shape prevents material accumulation.

A new type of gate valve greatly minimizes the possibility of interior clogging by slurries. Shape of the valve's interior and the sloping sides of the valve disk cause the slurry material to be recirculated in the body chamber when the valve is being opened or closed. This action prevents material from packing up.

If material does accumulate, purge holes are provided to introduce air, steam or water under pressure. This is sometimes necessary to break up certain kinds of material that flow sluggishly. Currently offered in a 4-in. size, the valves can be made of iron, carbon steel, brass or stainless steel.—**Everlasting Valve, Jersey City, N. J. 183A**

Vibration Damper

Bars most machine noise and vibrations.

Vibra-Check, a new antivibration material, eliminates 90% of machine noise and vibrational tremors, according to the manufacturer. Materials of construction include elastomeric vinyl plastic and monofilament glass fibers.

Outer layers of Vibra-Check have a resilient, low-density composition, while the central core is high in density. Any vibrational wave meets three different natural frequencies that prevent resonance, thus isolating the vibration. The low-cost material is impervious to oils, greases, detergents and solvent cleaners. Installation

Sperry Filter Presses can be made with new glass-reinforced Polyester plates and frames.

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Because Sperry Filter Presses are custom engineered for *flexible, volume production* and *elimination of waste materials* and *man-hours*, you can expect—and get—more efficient filtration at less cost! With a Sperry Filter Press the low first cost is virtually the only cost! Installation, depreciation and maintenance are minimized; down-time, all but eliminated.

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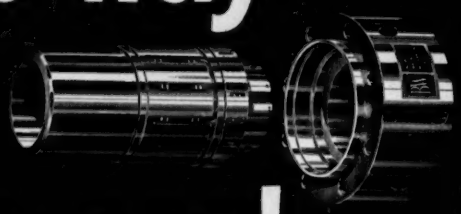
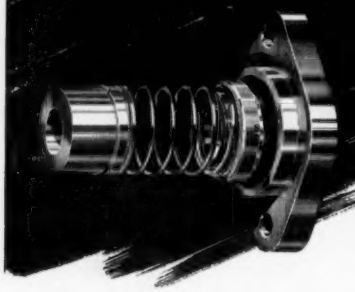


to seal

any pump!



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requires no bolts or adhesives. —**Lowell Industires, Inc., Boston, Mass.** **183B**

Pipe Sealant Tape

Takes place of brushed-on dope solutions.

Chemically inert tape designed to seal and permanently lubricate pipe joints eliminates the need for brushing messy dope solutions on pipe fittings. Applied by one person, a single wrapping affords full protection.

Made with a Teflon resin, the unfused film tape can withstand temperatures from the liquid-oxygen range to that of superheated steam. It is not affected by oil traces or other lubricants. Although nonadhesive, the tape is sufficiently cohesive to stick to its own glossy surface. Widths vary from ¼ to 8 in.; roll length is 36 yd.—**Minnesota Mining and Mfg. Co., St. Paul, Minn.** **184A**

BRIEFS

Gettering pump utilizes the chemical reaction between gases and titanium vapor to produce vacuums in the 50-micron to 1 x 10^{-9}-mm. Hg range. Said to cost less than 25% that of equipment previously available, the unit has a pumpdown speed of approximately 5 l./sec. In tests, two cartridges evacuated a 25-l. container from 50 microns to 0.1 micron in 8 min.—**NRC Equipment Corp., Newton, Mass.** **184B**

Checkweigher operates at speeds up to 20 units/min.

for a variety of package shapes and sizes. It automatically accepts or rejects to any set tolerance. Sound and marking devices for off-weights.—**Thayer Scale Corp., Pembroke, Mass.** 184C

Draft-gage line recently introduced includes single- and dual-tube models. The single-tube gages are available in six ranges, with maximum pressure readings of ½ to 4 in. H_2O; dual units are offered in four ranges, with maximum readings of ½ to 2 in. All models have an 11-in. scale. — **King Engineering Corp., Ann Arbor, Mich.** 185A

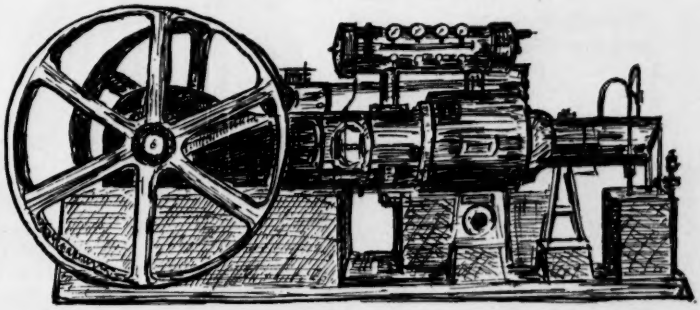
Remote selector switch that directs or stops flow of compressed air to pneumatic motors and valves uses a friction-reducing Teflon-resin disk in the switch body. The switch needs only 2⅜x3⅜ in. space. Over-all depth is 3¼ in. Air capacity is 580 cu. in./min.—**Powers Regulator Co., Skokie, Ill.** 185B

Pneumatic truck for bulk salt delivers at rates of 19 to 20 tons/hr; truck load is 19 tons. The air system utilizes a positive-displacement blower powered by tractor takeoff. Construction is aluminum. — **Sprout, Waldron & Co., Inc., Muncy, Pa.** 185C

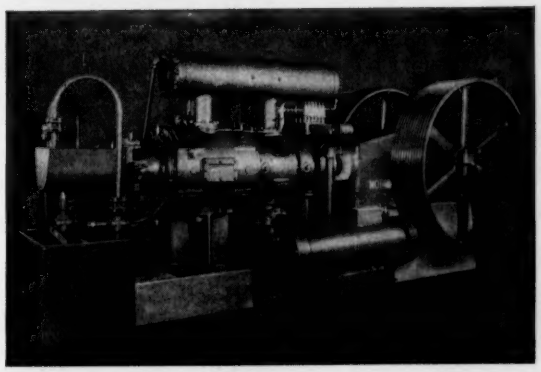
Flow control register makes accurate counts of unevenly spaced objects on a conveyor line. Performance tests have shown that more than 35,000 consecutive back-to-back items can be counted without a miss. Drive unit is a ⅓-hp. gearhead motor. — **Rapids-Standard Co., Inc., Grand Rapids, Mich.** 185D

Charger brings batteries up to full rating, and then automatically disconnects them. Having a charging rate of 6 amp., the unit operates from input voltages to 600 v. for batteries rated from 6 through 32 v.—**Automatic Switch Co., Florham Park, N. J.** 185E

Load-limiting relay gives positive protection against motor



Four stage, 14" stroke Norwalk compressor, installed in 1937 and operating satisfactorily at maximum speed today. User states "No carbon problem or indications of overheating of any sort."



This five stage, 14" stroke, heavy-duty tandem compressor is Norwalk's modern counterpart of the 1937 model shown at top. Develops 3000 lb. psig. in capacities up to 31,000 cfh.

Every Norwalk compressor is test-run at the factory, then taken down for complete inspection before re-assembly and shipment.

Norwalk makes compressors from single stage to six stages; from 125 to 25,000 psi pressure; for gases listed below:

ACETYLENE	**ETHYLENE**
AIR	**HCL**
ARGON	**HELIUM**
CERTAIN HYDRO CARBONS	**HYDROGEN**
	NITROGEN
CO and CO_2	**NITROUS OXIDE**
ETHANE	**OXYGEN**

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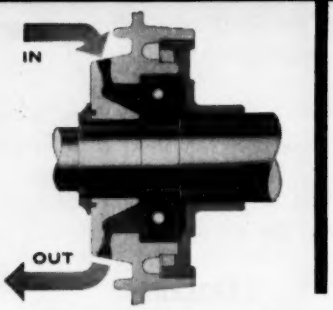
you choose the type of bearings

For most applications, open greasable bearings will serve dependably and economically. But for use where lubrication maintenance is difficult, Elliott offers a pre-lubricated cartridge type which requires no service lubrication.



OPEN GREASABLE BEARING

The drawings show how fresh lubricant, forced through bearings with motor running, positively flushes out old grease. Requires infrequent attention. Advance design prevents over-lubrication and protects against entrance of moisture.

PRELUBRICATED BEARING

No service is required for the Elliott cartridge-type factory-prelubricated bearing. Grease reservoir and internal cap help seal and protect the bearing

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overloads. Designed for use with pneumatic control systems, the V-26 can be applied to all makes of centrifugal compressors, fans, pumps and electrical heating systems. Current adjusts for 3-7 amp. **—Johnson Service Co., Milwaukee, Wis.** 185F

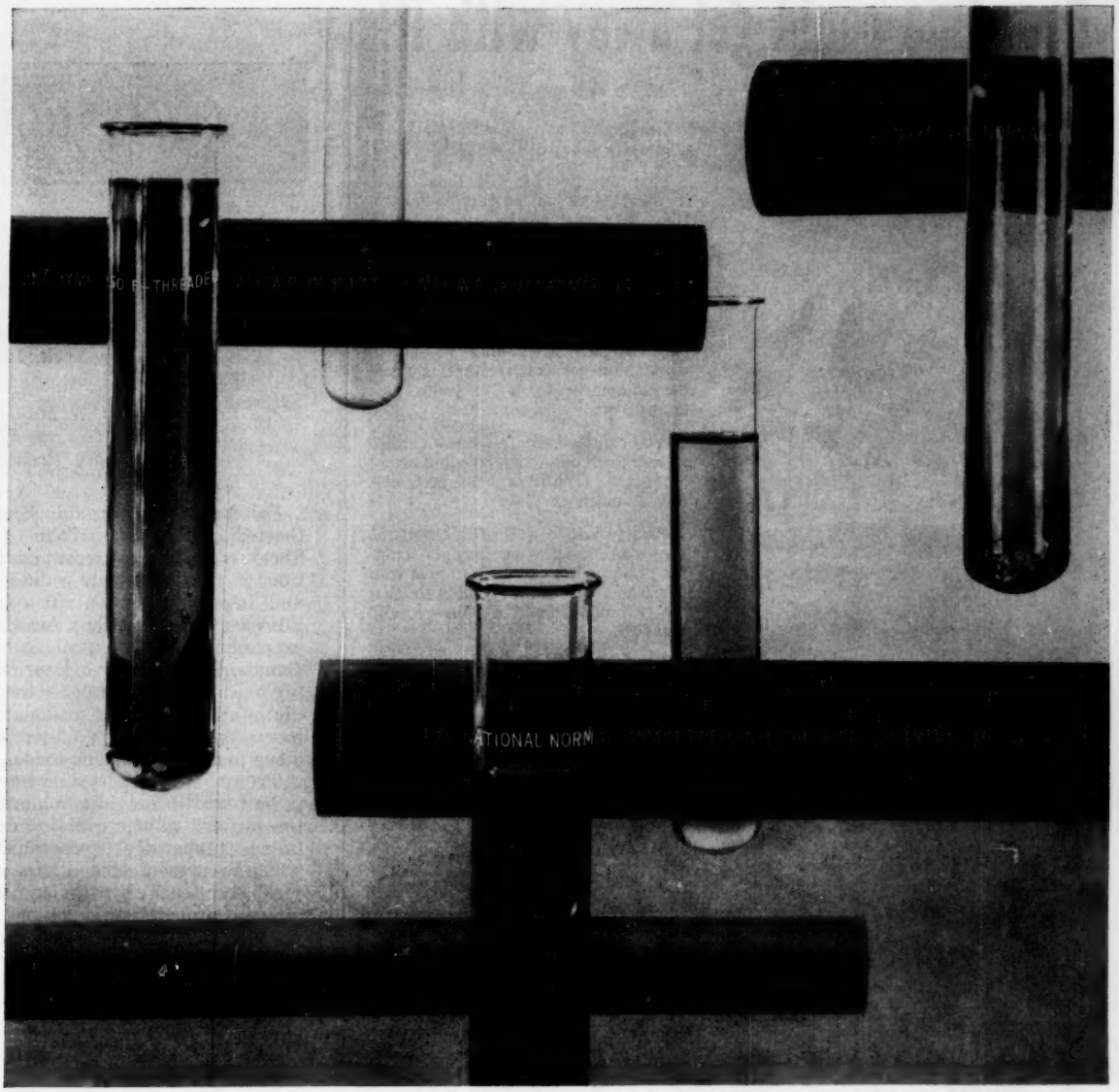
Air-cooled compressors deliver from 311 to 635 cfm. at 100 psi. Designated AP Series, the two-stage machines are designed for use at extreme temperatures and in areas where water is dirty, corrosive or exceptionally expensive because of short supply. **—Atlas Copco, New York, N. Y.** 186A

Speed-reducer line has been expanded by the introduction of a new fin- and fan-cooled model. The new right-angle P Series employs worm and gear reduction. It is available with a low base, high base or with no base, depending on end-use requirements. Sizes range from 1.33 to 5.25 in. center distance with a wide variety of reductions ranging from 1:1 through 60:1.**—Ohio Gear Co., Cleveland, Ohio.** 186B

Equipment Cost Indexes . . .

	March 1959	June 1959
Industry		
Avg. of all	232.6	234.3
Process Industries		
Cement mfg.	225.8	227.9
Chemical	233.7	235.7
Clay products	219.4	221.5
Glass mfg.	220.7	222.5
Paint mfg.	224.4	226.6
Paper mfg.	225.2	227.1
Petroleum ind.	229.2	231.4
Rubber ind.	232.0	234.3
Process ind. avg.	230.1	232.8
Related Industries		
Elec. power equip	236.5	246.7
Mining, milling	235.2	237.1
Refrigerating	262.2	264.7
Steam power	219.7	221.8

Compiled quarterly by Marshall and Stevens, Inc., of Ill., Chicago for 47 different industries. See Chem. Eng., Nov. 1947, pp. 124—6 for method of obtaining index numbers; Feb. 23, 1959, pp. 149-50 for annual averages since 1913.



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USS National Polyvinyl Chloride Pipe *does* handle acids, alkalies, salt solutions and alcohols as safely and efficiently as it transports water—that's one of the reasons why it's being used so widely in the chemical industry today.

There's no chemical corrosion with National PVC pipe, no building up of internal deposits. And it cleans easily, installs quickly, and has a low initial cost. Because National PVC pipe is plastic pipe, it does not contaminate sensitive solutions—*liquids remain chemically pure* inside National PVC.

USS National PVC Pipe comes in sizes from ½ inch to 14 inches in diameter, and Schedules A, 40, 80 and 120.

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For more information on USS National PVC pipe, write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pennsylvania. Ask for Bulletin No. 24. *USS and National are registered trademarks*

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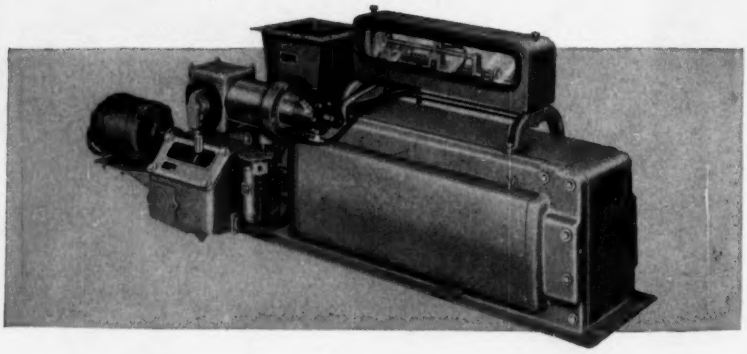

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TECHNICAL

On a High Level

ORGANIC SYNTHESES, Vol. 38. John C. Sheehan, editor. John Wiley & Sons, Inc., New York. 120 pages. $4.

Reviewed by J .R. Mayer, Sterling-Winthrop Research Institute, Rensselaer, N. Y.

Volume 38 of "Organic Syntheses," edited by John C. Sheehan, is the most recent addition to this extremely valuable and important series. It contains verified directions for the preparation of 31 organic compounds, including such interesting ones as dicyclopropyl ketone, diethyl methylene malonate, monovinyl acetylene, 1,4-pentadiene and trans-stilbene oxide.

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It would be difficult to overemphasize the importance of "Organic Syntheses" to the organic chemist, and the present volume should certainly be available to those who are engaged in synthetic organic chemistry.

An Appetizer

STATISTICAL QUALITY CONTROL: AN INTRODUCTION FOR MANAGEMENT. By D. H. W. Allan. Reinhold Publishing Corp., New York. 129 pages. $3.50.

Reviewed by Frank G. Norris, Wheeling Steel Corp., Steubenville, Ohio.

An introduction is intended to serve as an appetizer. This the author does, stopping just short of dulling the desire for meatier portions of the subject.

BOOKSHELF

J. B. BACON

Keynote of the theme that runs through the entire book is struck by the first word: "Variation."

Problems of variation are frequently of prime importance to chemical engineers in development, design and production. Some of the statistical methods for handling such problems include: control charts, acceptance sampling, linear regression, analysis of variance, and design of experiments.

The reader is introduced to these terms so that if he should encounter them again they will not be totally strange, and he can pursue the acquaintance further if he desires.

In these days of the team approach to problems, it becomes increasingly important to keep abreast of the terminology that is developing in fields only slightly overlapping your own.

This much is really all that can be expected of an introduction. The book accomplishes its purpose very deftly without diverting the sustained interest by formulas or details of computation.

The book can easily be read at one sitting. In fact once it is begun, it is unlikely that the interested reader will want to lay it aside.

BRIEFLY NOTED

COMPUTERS, 1937-58 (Catalog of Technical Reports. CTR-371) *Office of Technical Services, U. S. Dept. of Commerce, Washington* 25, *D. C.* 10¢. Lists all available reports in the field of computers from the OTS collection, identifies reports on digital, analog, mathematical and other computers.

SULFUR SAFETY DATA SHEET. 15 *pp. Manufacturing Chemists' Assn.*, 1825 *Connecticut Ave., N. W., Washington* 25, *D. C.* 30¢. Covers safety in unloading, physical properties of sulfur, engineering control, employee safety, handling, storage, tank cleaning, medical safety, etc.

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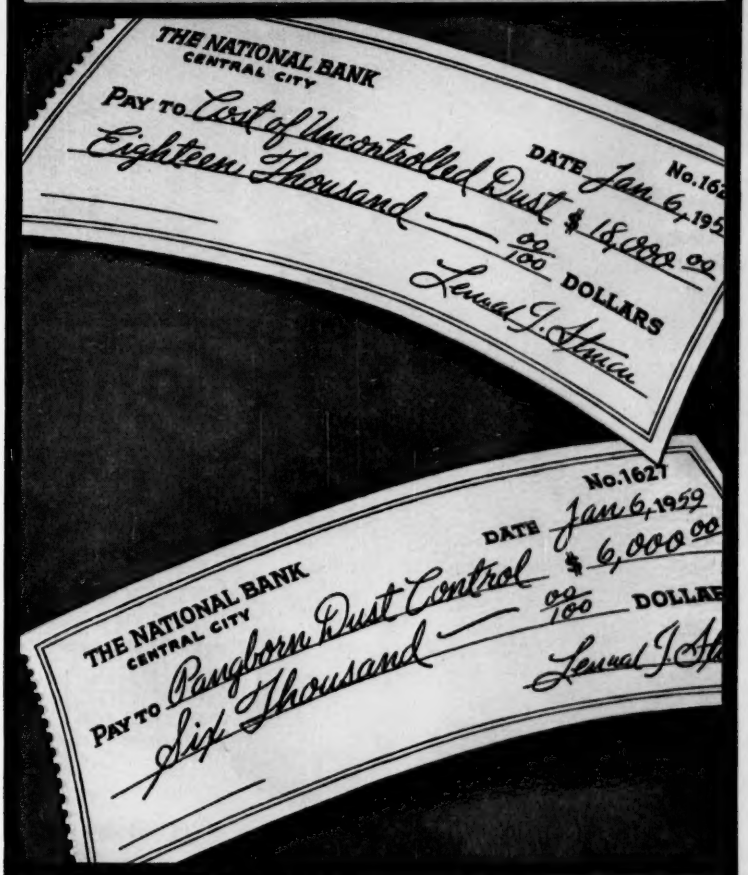

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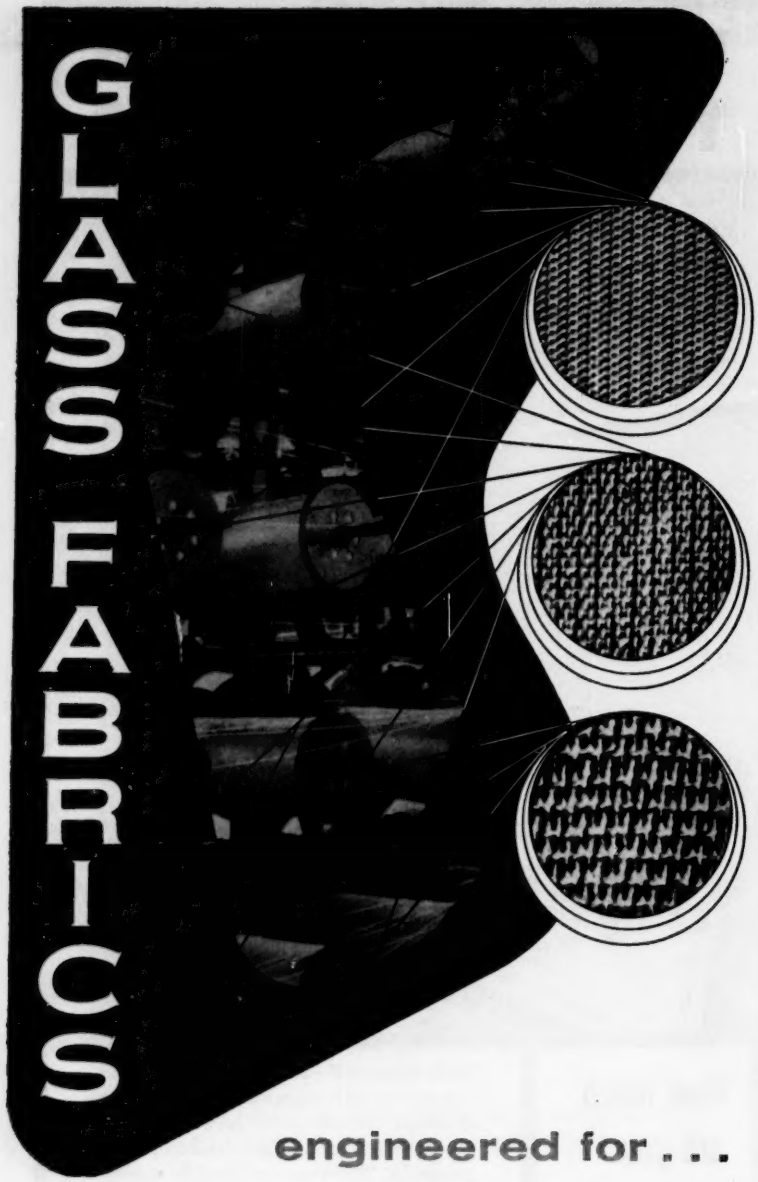

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LETTERS:

JUST BETWEEN US . . .

Dear Readers:

Many magazines in the industrial field have made changes in publishing frequency during the past several years. One of these, of course, was *Chemical Engineering.*

We have kept a careful box-score on every phase of our operations since switching from monthly to every-other-week frequency in January 1958. We now have a detailed breakdown on your reactions to the big change.

Indicative of your acceptance: Latest circulation audit shows our renewal percentage up by more than two percentage points to a new high. Paid circulation of the June 29, 1959, issue was a record high of 47,108. Your inquiries for more information on new products and literature are now running about 12% more per item than in '57. Reprint sales volume has risen 11%. Readership scores of major editorial departments have increased 10% as measured by our monthly surveys.

First investigations leading to the new frequency were launched several years ago, when we felt a need for a more pliable instrument of communication.

Initial reactions weren't encouraging. Some readers seemed inclined to feel that a frequency change would also mean a change in the character of the magazine you had come to rely on for job-oriented information. Many of you felt that more issues meant more reading, and you were already overburdened with reading matter.

As the months passed and the problems of keeping you up-to-date in a fast-moving field grew more acute, the editors became convinced that you would like the new frequency, once it became established.

First issue of the 26-a-year frequency was dated Jan. 13, 1958. As we suspected, accept-

PRO & CON

C. H. CHILTON

ance was not immediate nor unanimous; in that first month, our surveys showed that about 30% of you opposed the change. But within three months your letters and survey comments were running better than 18 to 1 in favor. The editors had won their point.

HUGH T. SHARP
Promotion Manager
Chemical Engineering

59 Times Too Small

Sir:

In N. H. Chen's article on condensing and boiling coefficients (Mar. 9, pp. 141-146), there appears to be an error in the nomenclature. In order for Eq. (8) to give the right answer, ϕ_2 must be defined in terms of σ', dynes/cm., rather than σ, lb. mass/ft.

It seems to be a small slip of the pen, but it results in a final value for the nucleate boiling coefficient approximately 59 times too small.

G. KOOPMANS
John Thompson-Leonard Ltd.
London, Ont.

▶ *Mr. Koopmans is right. However, the charts were correct as published.*—ED.

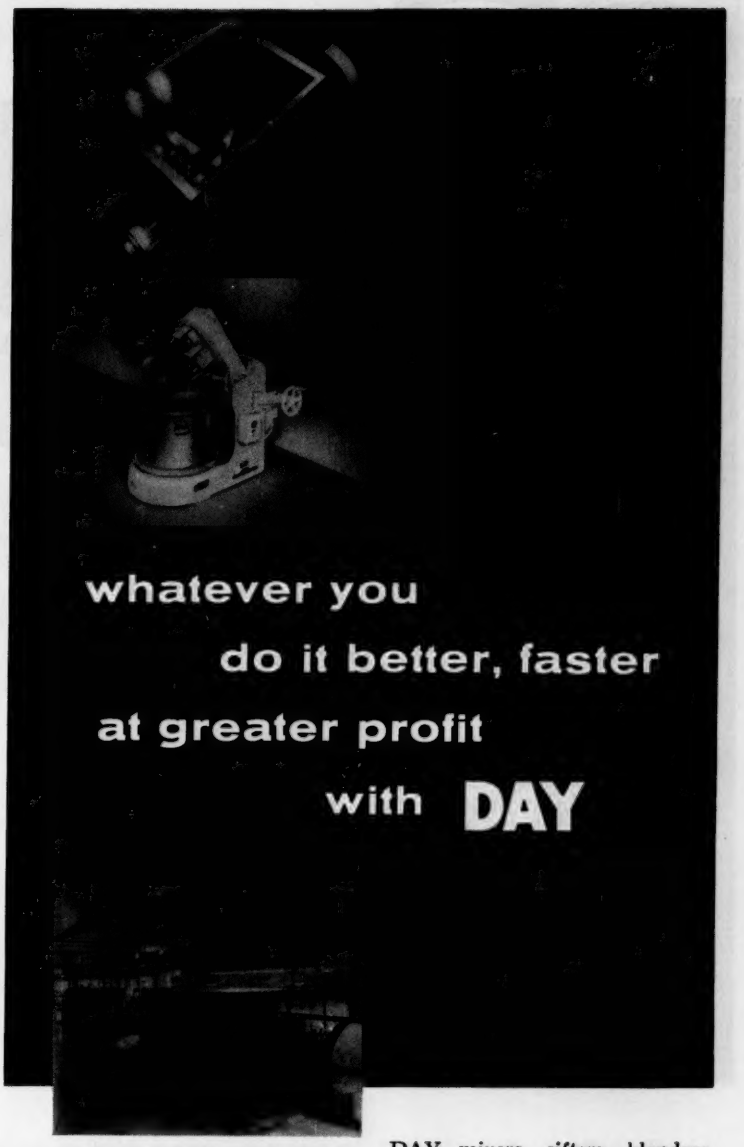
Engineers Aren't Scarce

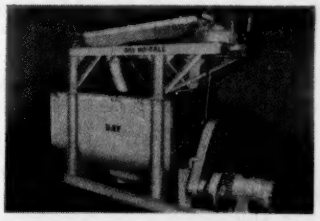
Sir:

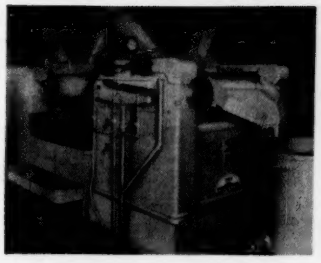
I would like to comment on the article, "Industry Speaks Its Mind on Engineering Education," in your June 29 issue (pp. 120-126).

I graduated from an eastern state university in June 1958 with a B.S. in Chemical Engineering. I had very close to a "B" average, I was in the upper third of my class, I had worked my way through school and I had been treasurer of my campus fraternity.

When I went looking for a job, I found that there were none. Engineers were not in demand.







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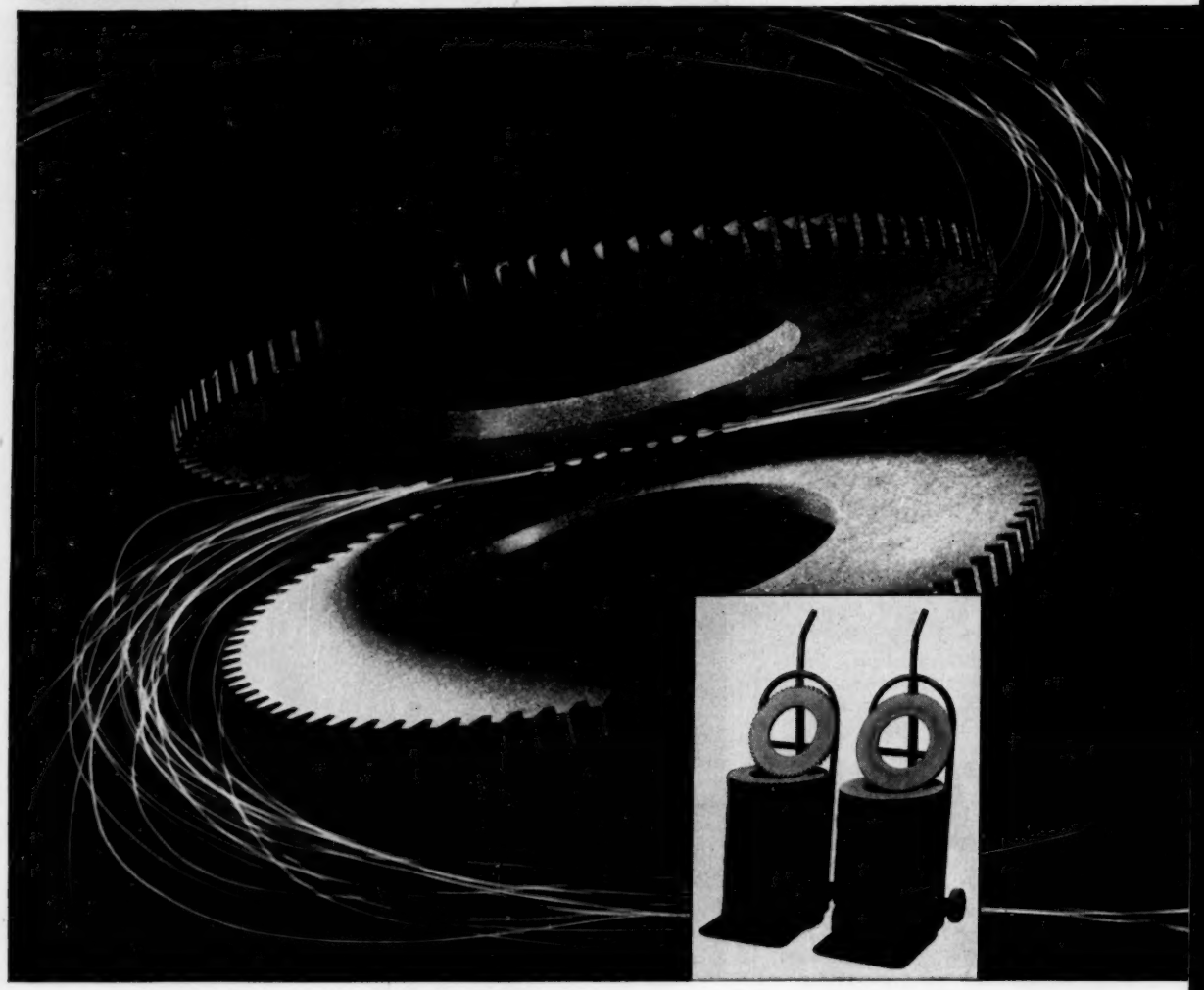

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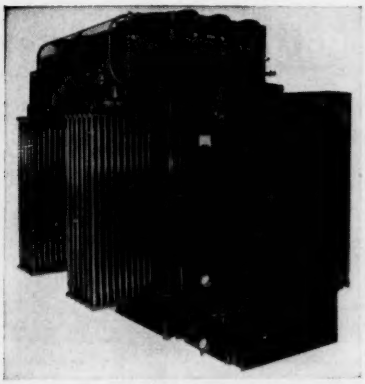

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Many members of my class went jobless for a few months; some were voluntarily drafted in the Army; some went to graduate school; and some were financially required, as I was, to take the first job that came along. In my case this turned out to be a sort of technical writing.

Despite the so-called scarcity of engineering graduates this year, the 1959 class, as I have heard from friends, is doing the same thing.

I therefore disagree with Mr. Spaght on his evaluation of the scarcity problem. Though he is executive vice president of Shell Oil Co. and trustee of Stanford University, I am closer to the problem than is he or President Eisenhower, who has been making similar statements.

The problem is not the scarcity of engineers, but the overabundance of engineers in non-engineering fields. Because of financial necessity, many engineers can't go jobless after graduation waiting for the *right* job; they must take the first thing that comes along. After a few years in these peripheral fields the engineer has forgotten many things learned in college, and industry is not interested in him any more.

NAME WITHHELD
Baltimore, Md.

Pro: Better Cooling

Sir:

I was very interested to read in your May 4 issue (pp. 145-146) the article, "Better (Not Less) Water Cooling."

I agree very much with the writer that the air-cooler circus band has been making a lot of noise recently, but this does not mean that the situation has fundamentally changed. Air coolers are indeed very useful means of cooling, but they are not the answer to every cooling problem. Cooling towers still have their place and must be considered and evaluated.

It is important to remember that there are, in fact, *four* major systems of cooling—cooling towers and air coolers, both of the mechanical and natural draft varieties. It is understandably natural for equipment manufac-

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Scoops cascade material as drum rotates. Movement forces material from both ends to middle. Thus blending is 4-way right from start of charging.

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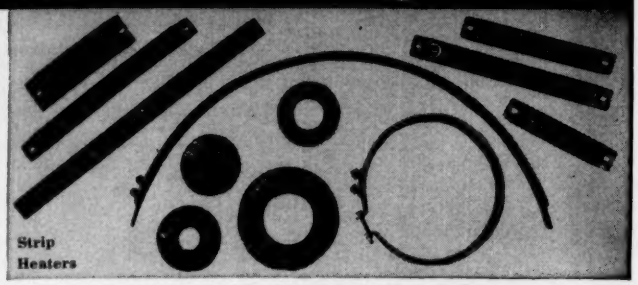

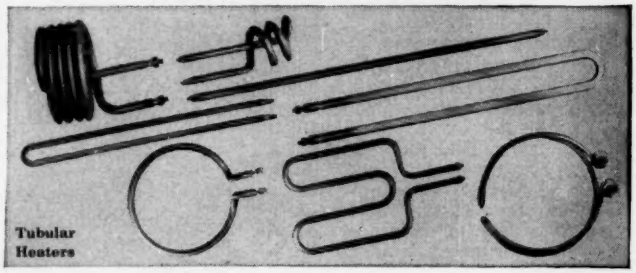

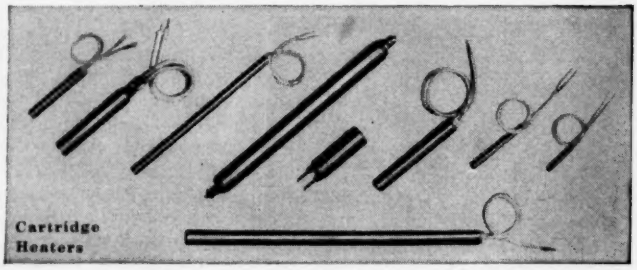

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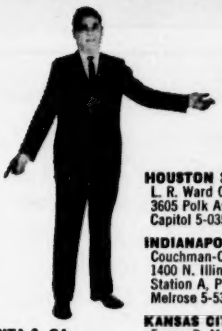

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Montgomery Brothers
1632 N.W. Johnson St.
Capitol 3-4197

RICHMOND 28, VA.
O. M. Thompson
Westhampton Station
P. O. Box 8762
Atlantic 8-8758

ROCHESTER 4, N. Y.
Niagara Electric Sales Co.
133 Clinton Ave. S.
Hamilton 6-2070

ST. LOUIS 1, MO.
C. B. Fall Company
317 N. 11th St.
Suite 1001
Chestnut 1-2433

SAN FRANCISCO 3, CALIF.
Montgomery Brothers
1122 Howard St.
Underhill 1-3527

SEATTLE 4, WASH.
Montgomery Brothers
911 Western Ave.
Main 4-7297

SYRACUSE 6, N. Y.
R. P. Smith Co., Inc.
2507 James St.
Howard 3-2748

WICHITA 2, KAN.
Fraser D. Moore Co.
Room 211 Derby Building
352 N. Broadway
Amherst 2-5647

EXPORT DEPARTMENT
1010 Schaff Building
Philadelphia 2, Pa.

turers to argue principally for the type of equipment that they supply.

Users should therefore discuss their cooling problems with manufacturers who have experience with all types of coolers. This should result in the most economical solution being formulated. As your writer says, in certain cases a combination of two or more of the main cooling methods may be the answer.

DEREK J. TOW
Chartered Mechanical &
Chemical Engineer
London, England

Crystallization Patents

Sir:

We have read your article, "Crystal Fractionation Beats Distillation," in your April 6 issue (pp. 80-82).

We wish to bring to the attention of your readers that continuous crystallization of naphthalene and anthracene was developed by us in the mid-Forties and that we have applied for and obtained patent protection for this process in several countries (U.S. 2,684,891, B. P. 664,376 and 811,559).

These patents are in the name of Staatsmijnen in Limburg (Dutch State Mines) and we, as a wholly owned subsidiary, are entrusted with the selling of know-how and the extension of licenses on patents owned by Dutch State Mines.

F. S. MULLER
Stamicarbon N. V.
Geleen, The Netherlands

METERING PUMP

• Floating Wear-plates compensate for gear wear, thermal reaction
• Hydraulically Sealed O-Rings in ground-lapped Housing Faces
• Grease-sealed Lantern Rings

Chemicals can't leak out . . . air can't leak in . . . No internal slip throughout its life.

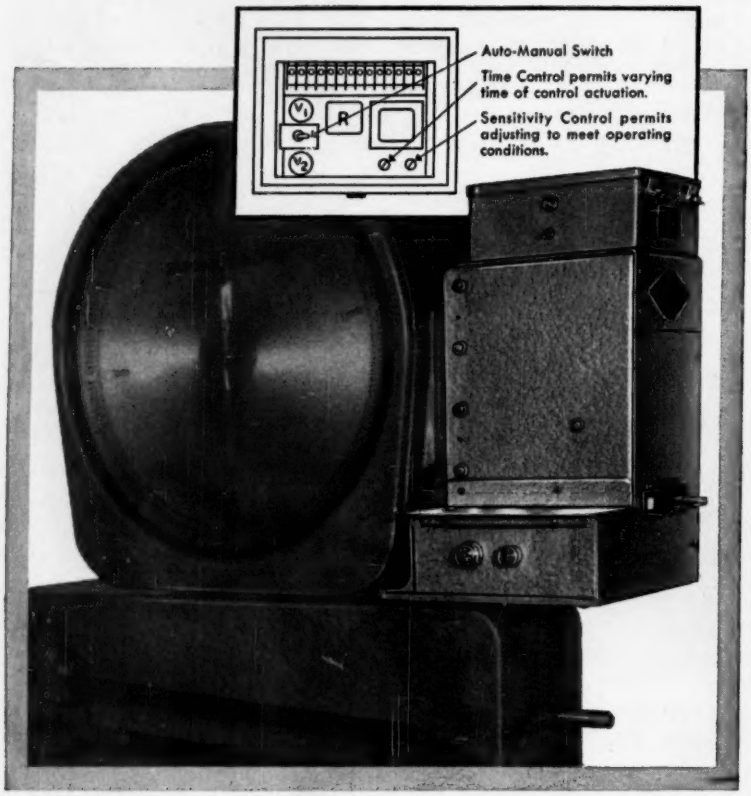
Specify GEARCHEM® for constant flow metering accuracy within ±1%.

Write for Catalog

ECO ENGINEERING COMPANY
12 New York Ave., Newark, N. J.

ECO
the big name in small pumps
for the process industries

NEW Fairbanks-Morse Electronic Weight Detector


Auto-Manual Switch
Time Control permits varying time of control actuation.
Sensitivity Control permits adjusting to meet operating conditions.

Prevents incorrect weighing . . . stops costly errors!

With the new Electronic Weight Detector, true weight of any load can be automatically obtained and recorded without need of a weighman. Where a weighman is used, it is impossible for him to record incorrect weights or start a sequence at the wrong time. When desired, a flip of the switch can disengage the Weight Detector entirely from the system. *This is the first fully-reliable control of its kind available in the scale industry.*

To completely automate your weighing—to be sure that your weights are correct—to protect yourself by completely policing your entire weighing operation—contact your nearby Fairbanks-Morse Field Engineer, or write directly to Fairbanks, Morse & Co., 600 South Michigan Ave., Chicago 5, Illinois for complete information.

See Sweet's Plant Engineering File for full line of F-M Scales

FAIRBANKS-MORSE
a name worth remembering when you want the BEST

SCALES • PUMPS • DIESEL, DUAL FUEL AND GAS ENGINES • ELECTRIC MOTORS
GENERATORS • COMPRESSORS • MAGNETOS • HOME WATER SYSTEMS

READER SERVICE . . .
TECHNICAL

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Heating & cooling	202
Instruments & Controls	203
Pipe, fitting, valves	205
Process equipment	207
Pumps, fans, compressors	213
Services & miscellaneous	214

Chemicals

Acetophenone.....New data on the reactions and pharmaceutical application of acetophenone are outlined in a 12 p. bulletin. Contains physical properties & specifications.
196A Union Carbide Chemicals

Adhesive.....for adhering paper labels to polyethylene containers has been developed. Claimed to form permanent flexible bond with all polyethylene surfaces.
33-34e *U. S. Industrial Chemicals Co.

Boron Trifluoride Neutron Detectors .....in wide range of sizes & several cathode materials are now available. Detect slow neutrons by B^{10} (n,a) reaction. No. 1502.
33-34h *U. S. Industrial Chemicals Co.

Carbon Wool.....Pure Carbon in fiber form can now be obtained in six standard types plus special grades. Said to have unusual combination of properties: heat resistance, etc.
33-34g *U. S. Industrial Chemicals Co.

Caustic Potash.....60 p. booklet presents the properties and handling of caustic potash based on company's own research, field experience and accepted sources.
196B Allied Chemical Corp.

Cellulose Acetate.....35 p. brochure discusses various types in terms of general properties, solubility in various solvents and solvent combinations, compatibility.
196C Eastman Chemical Products

Chemical.....A new 34-page brochure containing complete properties, known reactions, suggested uses & a comprehensive bibliography of National E-Caprolactam offered.
37 *Nat'l. Aniline, Allied Chem.

Chemicals.....8 p. bulletin contains an alphabetical listing of company's leading products and where you can buy them. Includes a section on principal trade names.
196D Allied Chemical

* From advertisement, this issue

LITERATURE

E. M. FLYNN

Chemicals.....Samples & technical literature on allyl alcohol, allyl chloride, bisphenol A, dimethyl ketone, epichlorohydrin, ethyl amyl ketone, etc. available.
Cover *Shell Chemical Corp.

Copolymers, Polyanhydride.....12 p. bulletin, "Water Soluble Copolymers of Ethylene-Maleic Anhydride," describes the products, properties of various formulations.
197A Monsanto Chemical Co.

Crystalline DL-glyceraldehyde.....3 phosphate diethylacetal (CAP) now available in research quantities. Can be converted to DL-glyceraldehyde 3-phosphate.
33-34i *U. S. Industrial Chemicals Co.

Deodorant.....for industrial use, said to be odorless & to control residual odors without paralyzing ole-factory nerves or masking, is now on market. No. 1500.
33-34f *U. S. Industrial Chemicals Co.

Elemental Fluorine.....New bulletin, "Handling Elemental Fluorine in the Laboratory" describes safe, simple method for handling, is now available.
57c *Allied Chem., General Chem. Div.

Esters, Methyl.....4 p. bulletin 415, "Metholene Esters for Alkylolamides", gives procedure for using methyl esters of fatty acids as intermediates to make "super" amides.
197B Emery Industries

Ethanolamines.....New booklet on Alkanolamines & derivatives is available. Application information is combined with physical properties specifications & shipping data.
96 *Union Carbide Chem. Co.

Ethylene Carbonate.....16 p. bulletin contains reaction & use information. Types of reactions included: hydroxyethylation, carbamate & imidazolidinone formation.
197c Dow Chemical Co.

Fatty Acids.....26 p. "Fatty Acids in Modern Industry" includes latest specifications on the line of Groco stearic & oleic acids, tallow fatty acids & glycerides.
197D A. Gross & Co.

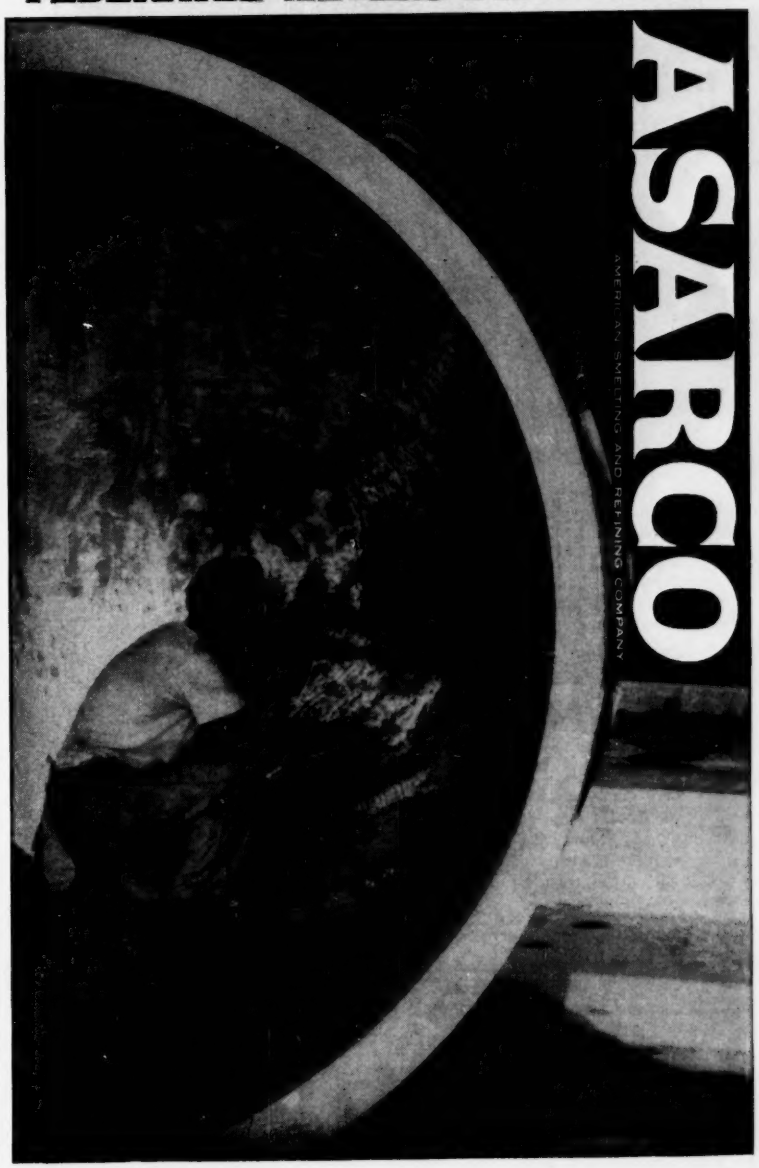
* From advertisement, this issue

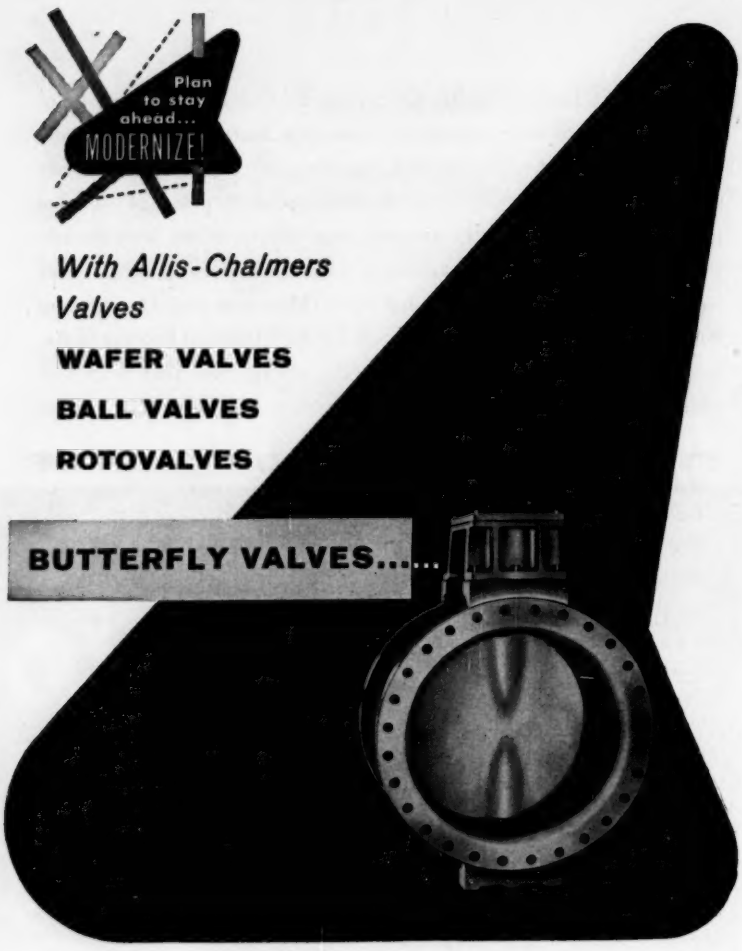
Want to build up your files and keep them up-to-date? You can get any publication in this comprehensive guide — free — just for the asking.

It's easy — simply circle item's number on the Reader Service Postcard and mail. Replies will come directly from companies offering the literature.

Federated Lead Fights Corrosion! Federated lead is one of the most efficient and economical protection materials against many acids. Lead is self-healing. Scratch it and a protective coating re-forms immediately. Lead is easy to work and moderately priced. Federated produces chemical lead in sheets to your requirements. Pipe, bends, traps and standard fittings available from stock. Special forms fabricated to order. Call the Federated Sales Office near you. Or write for Bulletin No. 162, the Lead Handbook for the Chemical Process Industries. Federated Metals Division, 120 Broadway, New York 5. In Canada: Federated Metals Canada, Ltd., Toronto and Montreal.

FEDERATED METALS DIVISION OF





To help solve your fluid and gas control problems, the broad line of Allis-Chalmers butterfly valves gives you:

Uniform Control In All Positions — You get consistent flow control through all positions in the normal regulating range. The flow curve within the broad control range is a straight line semi-log characteristic. Cam driven positioners can furnish other characteristics.

Fast Regulation and Closure — Speed of regulation and closing can be as fast as 1/10 second, or as long as system conditions require!

Minimum Pressure Drop Saves Power — In open position, the streamlined vane simulates Venturi action. Pressure drop is less than in many other valve types, helping to hold down your pumping costs.

Compact, Light Weight — Compact design and light weight permit more concise, space-saving layouts, cut construction and in-place costs.

For further information on Rotovalves, and butterfly, wafer and ball valves, contact your nearest A-C valve representative, or write Allis-Chalmers, Hydraulic Division, York, Penna.

Hydraulic Division — RESEARCH · DESIGN · HYDRODYNAMICS · ENGINEERING · FABRICATION

Rotovalves • Ball Valves • Butterfly Valves • Free-Discharge Valves

Hydraulic Turbines & Accessories • Pumps • Liquid Heaters

ALLIS-CHALMERS

LITERATURE . . .

Fluorine.....is readily available from two producing locations. The 21-page technical data bulletin, "Fluorine" is now available on request.
57a *Allied Chem., General Chem. Div.

Furfuryl Alcohol Resins.....are infusible, insoluble polymers when cured. Have low porosity. Information about uses, physical data & chemistry in Bulletin 205.
75 *The Quaker Oats Co.

Gibberellin-Alcohol Aerosols.....a highly accurate, convenient and economical means of applying gibberellin, the remarkable plant growth stimulant.
33-34c *U. S. Industrial Chemicals Co.

Hydrazine Flux.....for soldering electrical & electronic equipment is said to leave no rosin residue which is costly to remove. No. 1505 is available.
33-34k *U. S. Industrial Chemicals Co.

Industrial Fatty Acids.....New 250-pg. book covering their chemistry, production, processing & application can be purchased. Discusses com mercial derivatives. No. 1509.
33-34o *U. S. Industrial Chemicals Co.

Industrial Oil.....Stanoil contains a special antioxident which gives the oil resistance to chemical change. Has a high viscosity index, is resistant to temp. change.
99 *Standard Oil Co. (Indiana)

Ion Exchange.....A hard-cover 75-page handbook, "Dowex: Ion Exchange", covers the field from basic principles to processing applications. Available now.
14-15a *The Dow Chem. Co.

Isobutyl Alcohol.....8 p. bulletin B-104, "Eastman Isobutyl Alcohol" describes the chemicals use as a solvent and intermediate in making plasticizers and hydraulic fluids.
198A Eastman Chemical Products

Liquid Fluorine.....commercially available in tonnage & quantities. Further information is contained in booklet "Liquid Fluorine Unloading Procedure".
57b*Allied Chem., Gheneral Chem. Div.

Magnesium Hydride.....16 p. manual includes a general discussion of the metal hydrides with sections covering properties, reactions, uses, handling of magnesium hydride.
198B Dow Chemical Co.

Molten Sulphur.....Detailed instruction sheets & drawings are available on request for those interested in proper facilities for handling & storing molten sulphur.
47 *Texas Gulf Sulphur Co.

Nitrogen Tetroxide.....available in 125-cylinders or in tonnage quantities. Details on Nitrogen Tetroxide as a reactant & tech. assistance on your proposed application.
137 *Allied Chemical, Nitrogen Div.

Plastic.....Bulletin on Plastic Steel is now available. Easy to use as modeling clay . . . hardens to steel like strength in 2 hours . . . can be machined with regular tools.
L182 *Decon Corp.

Plastic.....Full information on Teflon expansion joints, tubes, thinwall tubing, rods, sheets, tape bondable Teflon & parts is contained in detailed literature.
178 *Raybestos-Manhattan, Inc.

* From advertisement, this issue

Protective Coatings.....Two 2 p. data sheets cover a clear protective finish for bright metals, G 7014 A, and a solvant resistant baked coating for aluminum, G 7079 A.
199A Gordon Lacey Chemical Products

Resins.....ideal for the toughest service conditions encountered in the chemical and petrochemical industries. Details available on request.
27
*E. I. du Pont de Nemours & Co. (Inc.)

Silicones.....and their uses are covered in new catalog. Uses described include: rubber products, cosmetics, polishes, electrical insulation, etc. No. 1507.
33-34m *U. S. Industrial Chemicals Co.

Sodium Borohydride.....as the blowing agent in a new process for making vinyl foams. Yields product with fine, uniform cell structure. More information available.
33-34b
*U. S. Industrial Chemicals Co.

Sulfur Trioxide.....6 p. booklet on stabilized form of product outlines proper methods of suing, emphasizes the cardinal points and successful handling of it.
199B Du Pont Co.

Textile Finishes.....Data file describes a complete line of textile finishing compounds. Includes a concise description of each. Indexed by product classification.
199C Onyx Oil & Chemical

Waxes, Sugar Cane.....8 p. "Cane Wax Aids" contains results of extended tests on products' use as additives in rubber processing. Tabulated data.
199D Western Petrochemical Corp.

Wet-Process Phosphoric Acid.....Innovation in phosphoric acid storage tanks—a reinforced concrete structure which will hold a million gallons of phosphatic fertilizer solution.
33-34a *U. S. Industrial Chemicals Co.

Construction Material

Alloy Castings.....Bul. 3354G contains 16-pages of information & data on chrome-iron & chrome-nickel castings necessary when corrosion, high temp. & abrasion must be resisted.
180 *The Duraloy Co.

Coatings.....A looseleaf brochure containing a full description of various coatings in LEC line, including specifications, application data, etc. is now available.
199E Lining Engineering Corp.

Hydrated Chromium Oxides.....are most stable of the green pigments. They are uneffected by acids, alkalis, vehicles, & solvents. Full technical data & samples offered.
181 *C. K. Williams & Co.

Insulating Cement.....Super "66" applies to any equipment, cold or hot. Effective up to 1800F. and contains a special rust inhibitive which prevents corrosion. Free Sample.
109 *Eagle-Picher Co.

Lead.....is one of the most efficient & economical protection materials against many acids. The Lead Handbook for the chemical process industries is offered. Bul. 162.
197 *American Smelting & Refining Co.

* From advertisement, this issue

FEED FLOW FASTER automatically WITHOUT STOPPAGE

The New FAIRMONT-built EASY-FLO bin device

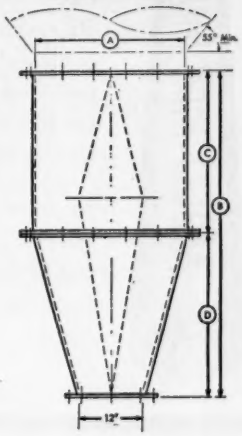
A Gravity Control Tap That Discharges Dry, Semi-Dry or Moist Bulk Solids in Loads up to 7000 Pounds per Minute.

This new FAIRMONT—built Easy-Flo Bin Device is designed and engineered to insure control and storage outflow of bulk solids that includes pigments, ores, plastic and metal powders and catalysts, etc., in forms of dusts, prills, pellets, granules, tablets, etc., in dry, semi-dry or in moist condition up to 12 per cent surface moisture.

The new FAIRMONT—built Easy-Flo Device regulates outflow by gravity . . . controls forces and conditions acting on material unloaded from the bins . . . speeds it up to 7000 pounds per minute without stoppage!

A low pressure discharge outlet eliminates costly gates and similar cut-off equipment. The double-cone stainless steel gravity element automatically maintains the material in an unpacked state once it passes from the storage bin into the Device.

Ruggedly constructed of non-movable parts, the FAIRMONT—built Easy-Flo Bin Device is precision fitted and durably bolted to eliminate vibration and excessive wear, and to cut out maintenance and repair. Three standard sizes for permanent installation are available.



SIZE	A	B	C	D
1	24"	50"	27½"	22½"
2	28"	60"	30"	30"
3	36"	88"	43¼"	44¾"

NOTE: It may be necessary to install a transition hopper with the Easy-Flo Bin Device.

When requesting additional information include layout and details of existing equipment, capacity of bin (cu. ft.), and size, screen analysis and surface moisture of material to be handled.

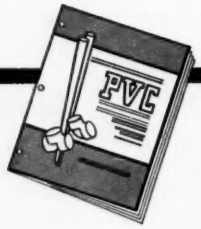
FAIRMONT MACHINERY COMPANY
FAIRMONT, WEST VIRGINIA
ENGINEERS • DESIGNERS • FABRICATORS and CONSTRUCTORS

THE CORROSION-FREE WAY
to handle chemicals

MUELLER BRASS CO. PVC (POLYVINYL CHLORIDE)
RIGID PLASTIC PIPE AND FITTINGS

The answer to most chemical corrosion problems can be found in an installation of Mueller Brass Co. PVC rigid plastic pipe and fittings. PVC pipe has proven itself invaluable to the chemical industry because of its high resistance to corrosion. Water, oil, gases, alkaline or salt solutions, alcohol and a wide variety of acids have no deteriorating effects upon PVC. Its extremely smooth interior bore eliminates pipe clogging and fouling and assures continuous maximum flow capacity. PVC is exceptionally strong, retaining its dimensional stability under stress, impact and moderately high temperatures. Mueller Brass PVC's life long built-in finish reduces maintenance costs and completely eliminates the need for painting or other protective coating. It is light and can be easily joined by threading or solvent cement, thus saving on installation time and expense.

For more efficient, economical and corrosion-free systems, specify Mueller Brass Co. PVC plastic pipe and fittings.



NORMAL IMPACT PVC—good impact strength . . . maximum chemical resistance.

HIGH IMPACT PVC — maximum impact strength . . . high chemical resistance.

Pipe is fabricated in 20' lengths; ½" through 3" sizes—I.P.S. schedules 40 and 80. Fittings are available in ½" through 3" sizes; threaded and socket-type for schedule 80 and in socket-type only for schedule 40.

Write for the new Mueller Brass Co. Technical Brochure.

MUELLER BRASS CO.
PORT HURON 51, MICHIGAN

274-A

POLYETHYLENE PIPE AND PLASTIC FITTINGS, COPPER TUBE, VALVES AND FITTINGS

LITERATURE . . .

Mechanical Seals.....A new file folder of designs shows some of the many types & applications possible for pumps, mixers, autoclaves & special rotating shaft problems.
184 *Borg-Warner

Mechanical Seals.....They seal against all mediums including solids in suspension in pressures up to 100 psi at 75° C, or 75 psi at 100°C. Details in Catalog AD-164.
174 *The Garlock Packing Co.

Metals.....Complete information on metals and on stainless steel castings is contained in the new technical bulletin which is now available.
103 *Waukesha Foundry Co.

Mineral Filler.....Celite diatomite absorbs its own weight of liquid . . . yet stays dry. Technical data on specific mineral filler or filtration problems is available.
175 *Johns-Manville

Nickel-Clad Steel.....resists general corrosion and prevents stress-corrosion cracking. For answers to your corrosion problems, see Technical Bulletin T-29.
95 *International Nickel Co., Inc.

Protective Coatings.....for steel tank linings, concrete tank lining, tank cars, concrete floors, etc. Booklet describes the protective coatings.
R213 *Wisconsin Protective Coating Co.

Rubber Surfacing.....Benefits of experience in designing, engineering & producing rubber components & applying it to the most intricate surfaces, is described in bulletin.
85 *Industrial Filter & Pump Mfg. Co.

Stainless-Clad Steel Plates.....widely used by equipment fabricators in application where only one side of the plate will be exposed to damaging conditions. Details.
226 *The Colorado Fuel & Iron Corp.

Stainless Steel.....Information on all services in stainless steel are available on request. Included are plate, plate products, heads, rings, etc.
149 *G. O. Carlson, Inc.

Tantalum Equipment.....Equipment includes heat exchangers, evaporators, stills, condensers, coils, etc. Samples of metals for testing are available upon request.
71 *Fansteel Metallurgical Corp.

Titanium.....Tech. Data Sheets on "Cost Cutting Ideas in Titanium" for: Pulp & Paper Industry, Chem. Valves, Pumps & Accessories, & Metal Treating Applications.
145 *Mallory-Sharon

Titanium.....Detailed results of a comprehensive test undertaken to confirm titanium's outstanding corrosion resistance, contained in summary report. Available now.
63 * Union Carbide Metals Co.

Electrical & Mechanical

Electrical Equipment.....available in four materials to meet corrosion problem. Full information available in bulletin "Condulets for Corrosive Locations."
52 *Crouse/Hinds

* From advertisement, this issue

Equipment.....Bulletins containing selection data on Dyna-V Drives, drive data on Chain & Sprockets, and ratings & data on Roller Bearings are available.
165 *Dodge Mfg. Corp.

Extension Cable.....Thermo-Cable is available in 6, 14, 18, 25, 39 or 56 pairs and comes in all standard thermocouple materials. Details in Wire Section 33-E.
B166 *Thermo Electric Co., Inc.

Fasteners.....A full range of sizes and types in AN and MS fasteners are among the new items covered in the latest manufacturer's catalog. Copy on request.
201A Star Stainless Screw

Floodlights.....Miniature edition of catalog includes sections on floodlight selection, heavy-duty units, lights for hazardous areas, accessories and installation.
201B Crouse-Hinds Co.

Gear and Fluid Drives.....Information on an extensive line of standardized gearmotors, Motogears and fluid drives has been combined into one new 48-page booklet.
201C Link-Belt Co.

Motors.....C-W SEALEDPOWER motors now available up to 300 hp, in totally enclosed, fan-cooled & explosion proof designs. All the facts in new Bul. PB6000-2.
186 *Elliott Co.

Motors.....for all atmospheric & hazardous conditions. Complete factual information on chemical & explosion-proof motors contained in Bulletin SB-185.
28 *Marathon Electric Mfg. Corp.

Motors.....Varidrive Motors are available in ratings: ¼ to 75 H.P. One compact, self-contained unit. Coor-brochure is offered. Bulletin No. 1797.
45 *U. S. Electrical Motors, Inc.

Motors & Generators.....Direct current motors & generators with frames 180 thru 580 are covered in a new bulletin. Includes construction features & applications.
201D Marathon Electric

Motors, Open-type.....Super-Seal opentype motors feature Poxeal & Silco-Flex insulations. Results of endurance tests and other important information available.
100 *Allis-Chalmers

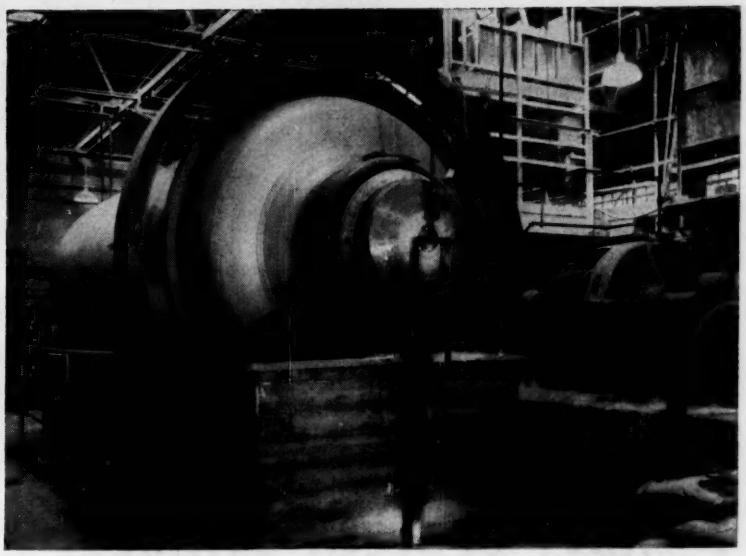
Packaged Substations.....Comprehensive information describing a line of completely packaged, compact unit substations is furnished by a new bulletin. Ratings to 2,500 kva.
201F I-T-E Circuit Breaker Co.

Roller Bearings.....Catalog 59A covers a complete line of self-aligning roller bearings. Specifications, lubrication, seals and installation features are included.
201F Chain Belt Co.

Sheaves.....Why the Adjustex sheave pays off in lower initial cost, reduced length and improved balance at all pitch diameters is told in literature just released.
201G Allis-Chalmers

Speed Reducer.....Torque-Arm Shaft Mounted offers capacities up to 170 hp & either single or double reduction. Over-load release & built-in backstop are optional.
164 *Dodge Mfg. Corp.

* From advertisement, this issue



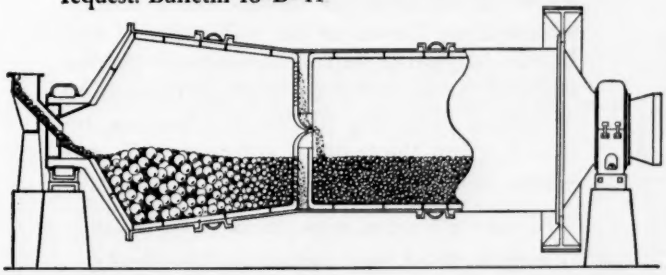
Hardinge 9′ x 22′ Pebble Tube Mill Wet Grinding Zircon in Open Circuit.

Hardinge TUBE MILLS...

...for wet grinding
(in water or acid pulps)
Titanium Pigments
Manganese Dioxide
Diatomaceous Earth
Limestone

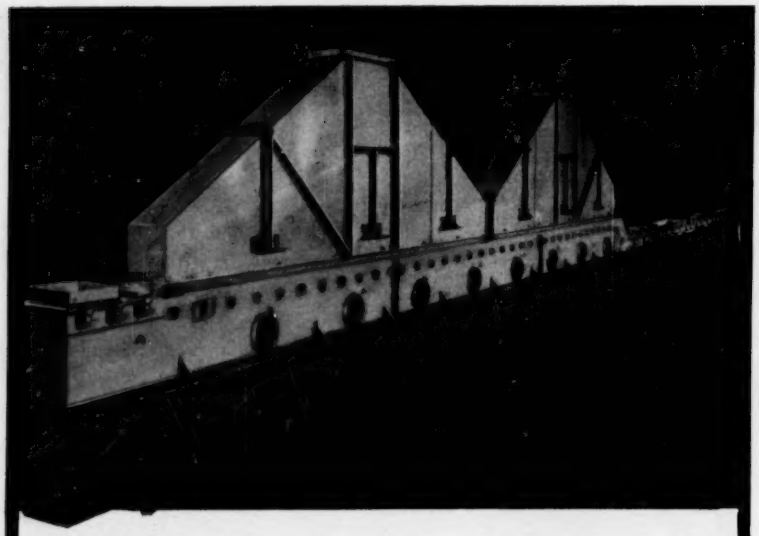
...for *dry* grinding
Fillers
Silica Flour
Gypsum
Carbon Black
Pigments
Cement materials

Regardless of the requirements, Hardinge Tube Mills are designed to meet specific needs. Available from 2 to 10 feet in diameter; 6 to 35 feet in length; single or multiple compartments; with acid proof lining of rubber, silica and porcelain. Complete specifications on request. Bulletin 18-B-11



Tricône compartment Tube Mill with grate and lifters.

HARDINGE
COMPANY, INCORPORATED
YORK, PENNSYLVANIA • 240 ARCH ST. • Main Office and Works
New York • Toronto • Chicago • Hibbing • Houston • Salt Lake City • San Francisco • Birmingham • Jacksonville Beach



DRY! SCREEN! CONVEY!

ONE Carrier Conveyor Does It All!

A well-known chemical processor needed a unit that would *dry* and *convey* 5/16" carbonaceous particles at a rate of 2 TPH (on a limited floor area).

This efficient Carrier Natural-Frequency Dryerveyor (60' long, 12" wide) *filled the bill!* It reduced conveying, drying and maintenance costs, and Carrier pre-assembly made installation easy.

This custom engineered Carrier Dryerveyor has an easy-to-adjust dual drive that permits two different conveying speeds—one for drying (2 TPH) and one for standard conveying (15 TPH).

The moist particles are quickly dried by the 350°F. air which passes through them as they vibrate along the screen deck. The drying section is designed to expand or contract without stressing the structural parts. *Particle moisture is reduced from 14% to .5%* and fines are removed before the material enters the 30' conveying section.

For more information, write: Carrier Conveyor Corporation, 213-A North Jackson St., Louisville, Ky.

CARRIER
-NATURAL-FREQUENCY®
VIBRATING EQUIPMENT
Engineering Specialists in Vibrating Equipment

CONVEY ● FEED
DEWATER ● SCREEN
COOL ● AGGLOMERATE
DRY ● SCALP ● COAT
DISTRIBUTE ● ELEVATE
● FLATTEN BAGS

Handling & Packaging

Aluminum Cans.....Brochure on standard drawn round aluminum cans catalogs 335 standard stock sizes ranging in diameter from 11/16 to 25 in. Heights as needed.
202A American Aluminum Co.

Bin Device.....A gravity control tap that discharges dry, semi-dry or moist bulk solids in loads up to 7000 lbs. per minute. Three standard sizes for permanent installation.
199 *Fairmont Machinery Co.

Bin Vibrators.....Catalog on "pulsating-magnet" electric vibrators for keeping bulk materials flowing from bins, hoppers and chutes is topic of illustrated catalog.
202B ....Syntron Co.

Container, Chemical.....protect dangerous or corrosive products, eliminate accidental breakage, and safeguard handlers. Size: approximately 17 5/16" x 22⅛".
13 *Pressed Steel Tank Company

Dryerveyor.....has an easy-to-adjust dual drive that permits two different conveying speeds—one for drying (2 TPH) & one for standard conveying (15 TPH). Information.
202 *Carrier Conveyor Corp.

Fork Trucks.....New folder illustrates and describes a new line of heavy-duty fork trucks known as the Titan Series. Capacities range from 12,000 to 20,000 lb.
202C Elwell-Parker

Hopper Scale.....Standardized components adapt it to a full range of material handling methods, control instrumentation. Cat. 12 offered.
L204
*Weighing & Control Components

Material Handling System.....Complete details on modern unloading, blending and distributions and storage systems is now available. Bulletin I-47.
42 *Sprout-Waldron

Pneumatic Materials Handling Systems.....The range of equipment offers the best single source for solving problems in moving dry bulk materials pneumatically. Lit.
144a *Fuller Co.

Rotary Feeders.....Rotary feeders can be used as feeders, airlocks or explosion shecks. "Tips On Choosing Rotary Feeders helps engineers select right feeder for job.
202D Sprout, Waldron & Co.

Vane-type & Roll Feeders.....for volumetrically controlled feeding of a wide range of dry pulverized or granular materials. Detailed literature offered.
144c *Fuller Co.

Heating & Cooling

Boilers Two-Pass.....Bulletin compares the features of Continental 2-pass boilers with 3- and 4-pass designs. Section is devoted to analysis of heat transfer in tubes.
202E Boiler Engineering

* From advertisement, this issue

Generator.....All Model AA Generators are designed to operate at top efficiency over a modulation range of 20% to 100% of rating. Details on new model AA Package Boiler.
73 Ames Iron Works, Inc.

Grate Coolers.....Horizontal & Inclined Grate Coolers are compact, easily installed for fast, efficient cooling of modulized phosphate rock, pebble lime, etc.
144e *Fuller Co.

Heat Exchangers.....constructed so that all surfaces in contact with corrosive fluids are of "Karbate" impervious graphite. Catalog Section S-6800 is offered.
87 *Nat'l Carbon Co.

Heaters, Cartridge.....that smoothly fits standard drilled holes in dies, platens, molds, extrusion & injection barrels. Diameters from 3/8 to 1-19/64 inches. Cat. 60.
194d *Edwin L. Wiegand Co.

Heaters, Electric.....are available in sheath materials & wattages to match almost any application to 1100 F. New Catalog 60 provides detailed product information.
194a *Edwin L. Wiegand Co.

Heaters, Strip.....Lengths from 4 to 96", widths from 3/4 to 2½", with cross section curving or lengthwise bending. Available with brazed-on fins. Catalog 60.
194b *Edwin L. Wiegand Co.

Heaters, Tubular.....Straight lengths or factory-formed to nearly any contour. Lengths from 6 inches to 30 feet. Triangular or round cross section. Catalog 60.
194c *Edwin L. Wiegand Co.

Heating Mantle.....New, aluminum mantle designed for heating heavy-walled vessels in which vacuums must be created to permit the drying of various samples.
65 *Glas-Col Apparatus Co.

Preheaters.....Humboldt suspension type preheaters for preheating dry, pulverized Portland cement raw materials with rotary kiln waste gases. Literature.
144d *Fuller Co.

Thermo-Panels.....Heats, cools, dries, without pipe coils. Many applications in the chemical field. Complete prices on the latest heat-transmission models available.
TL212 *Dean Products, Inc.

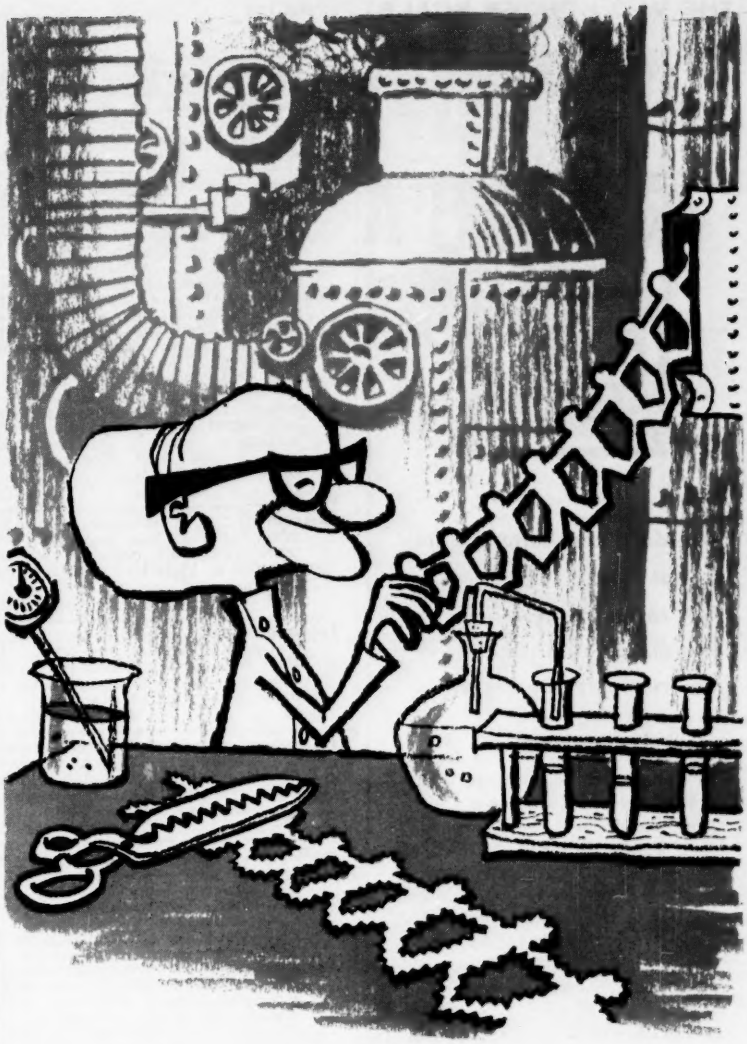
Instruments & Controls

Analyzer.....Data File P-6 gives detailed specifications on an oxygen analyzer that withstands tough environments & gives you continuous, dependable answers.
79 * Beckman Instruments Inc.

Control Panels.....Details of construction, dimensions, weights, instrument mounting and accessories for six styles of control panels is topic of Pro. Spec. G71-7.
203A Bailey Meter Co.

Control Panels.....permit automatic, remote, one-man control of multiple operations. Easily-read panel permits visualizing flow of material to storage or from process bins.
144g * Fuller Co.

* From advertisement, this issue



The man who knows his process equipment . . . chooses G-B Evaporators!

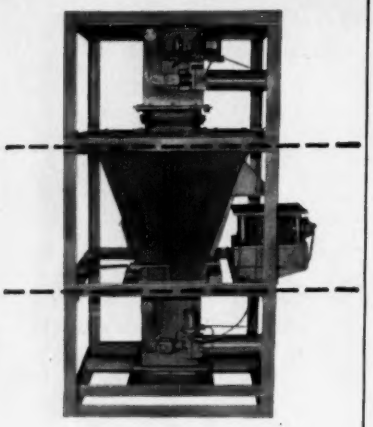
To guarantee results such as Doctor Hector's equipment produces is just a little out of our line, but you will find G-B Evaporators in many of America's major paper processing industries.

Men who know their process equipment in the paper, aluminum, sugar and other chemical fields have been specifying G-B Evaporators since 1879.

It would make us very happy to fill your request for facts, figures and case histories of experts who have chosen G-B equipment. All we need is your name and address. Please send.

GOSLIN-BIRMINGHAM
MANUFACTURING CO., INC.
P.O. BOX 631 • BIRMINGHAM, ALABAMA

THE W-C HOPPER SCALE



standardized components adapt it to a full range of material handling methods, control instrumentation

Take a good look at this hopper scale. It has many practical features for almost any weighing application.

Take the upper and lower frames. They are designed to accommodate many standardized feed and discharge components: sliding gates, vibratory feeders, screw feeders and others. These units are pre-engineered; their performance has been fully proven in use. Costs are, therefore, correspondingly lower. Satisfactory operation is confirmed in advance.

Now look at the middle or hopper frame. Note the flexure mountings. They give stability to the unit and deliver a single component of force to the weight transmitter regardless of load distribution. The transmitter, itself, may be either electric or pneumatic; the signal can be used for weight indication, recording, automatic batching.

Write for Catalog 12.
Clear text, lots of pictures.

W-C

S.A. 1659

WEIGHING and Control COMPONENTS, Inc.
206-R Lincoln Ave., Hatboro, Pa.

LITERATURE . . .

Densitometer-Integrator....New folder provides description of the Analytrol Model RB, a curve-drawing densitometer-integrator. Accurately measures colored material.
204A Spinco Div.

Electronic Weight Detector.....true weight of any load can be automatically obtained & recorded without need of a weighman. Complete information on request.
196 * Fairbanks-Morse

Gage Illuminator.....The new EPL-56 model gives 3 times the illumination & 3 times the bulb life. Data Unit on process gage illuminators is offered.
L206 * Jerguson Gage & Valve Co.

Indicators.....**Material-Level-Indicators** signal audibly & visibly when materials reach a predetermined high or low level. Controls conveyor motors, valve circuits, etc.
144f * Fuller Co.

Instrument.....Thermopositor, an instrument that has been used extensively in air pollution studies, is topic of bulletin. Complete description and application.
204B American Instrument Co.

Instrument.....Bul. 13-23 fully illustrates & describes the Type 14A Pneumatic Integrator, & points the way to economical accounting of process & plant service flows.
48 * The Foxboro Co.

Instrument.....Elect-O-Level provides a continuous indication for level measurement & control of liquids solids, viscous fluids, acids & granular materials. Bul. L-1053.
224 * Instruments, Inc.

Moisture Instruments.....Type 26-350 high-pressure Moisture Monitors are described in Bulletin 1855. Applications, specifications and operating features.
204C Consolidated Electrodynamics

Instrumentation.....Complete line of full-size & miniature instruments for measurement, recording, automatic control & telemetering of almost every industrial variable.
40 * The Bristol Co.

Liquid Level Controls.....for use with single & multiple pumps, motor & solonoid valves, storage tanks, waste sumps, etc. The 32-page Catalog gives complete specifications.
T214 Charles F. Warrick Co.

Logger-Scanner.....All purpose 120-paint logger-scanner system offers the ultimate in accuracy, flexibility, dependability & simplicity of maintenance. Details.
16-17 * Minneapolis-Honeywell

Meters, Industrial.....can measure most any piped liquid—oil, liquors, paints, chemical solutions—over 50 liquids in all. Full details are available.
31 * Rockwell Mfg. Co.

Pressure Gauges.....Both vapor tension & gas-filled types are available in either distant reading or rigid stem types. Thermometer Catalog covers complete line.
T222 * Marsh Instrument Co.

Pressure Regulators.....Two new differential pressure regulators for steam service are the topic of a new catalog sheet. Range of pressure adjustment is 5 to 45 psi.
204D Atlas Valve Co.

* From advertisement, this issue

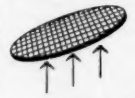
a filter man's thinking

"Expediency: when time is more precious than gold (or platinum)"

BY JULES P. KOVACS, V. P., PUROLATOR PRODUCTS, INC.

There's more than one way to skin a cat . . . or filter a chemical that fights any attempt to tame it.

As an example, here's a problem we recently licked in developing a diffusion plate bed support for a highly corrosive gaseous fluidized bed reactor, operating at very high temperatures. Pore size had to be 25 microns, able to support 20 psi. And it was needed in a *hurry*.



Now, anyone who knows filters could pick metals for such a job. The obviously ideal medium would be inconel. Trouble was, it was impossible to obtain a fine enough inconel screen. Of the only other metals that could withstand the corrosive action, gold lacked high temperature strength; platinum was too weak without support and too costly, though it did offer the high temperature strength and corrosion resistance needed. And that's where Purolator's special capabilities came into play.

Our engineers solved it by combining the finest mesh size of platinum available–150–with a fused facing of porous gold powder to reduce pore size to the specified 25 microns — and supported by inconel grids. Problem solved. Customer deadline met.

But the story doesn't end there. Purolator engineers immediately set about to find a way to take advantage of standard inconel mesh economy for similar applications. This is how we do it: inconel metallic edge type units are sliced in two, and two of equal thickness are punched out. One is rotated 90° from the other and fused by Purolator's exclusive process. By carefully controlling the amount of fusion material, we produce the exact pore size required. Simple?

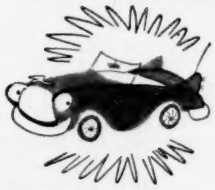
It's *not* simple, of course. But it's typical of Purolator's complete service for special jobs. We live with challenges all the time. Want to read about some? Our brochure called "New Roles for Filtration" is just off the press and it will be interesting reading. Send for your copy.

Filtration For Every Known Fluid

PUROLATOR
PRODUCTS, INC.
Rahway, New Jersey and Toronto, Ontario, Canada

Sonic puts ULTRASONICS to work

..in Polishes for a shinier shine and a longer protection a major polish manufacturer now homogenizes their polish ultrasonically. The better their blend the better their polish, they found... and the smaller the particles the better the blend. The Dispersonic gave them the smaller particles at a fraction of the first cost and power of conventional equipment... and paid for itself in one year by lowered maintenance costs.



..in Insecticides the problems of the insecticide chemist just begin when he finds a good insecticide. Then he must feed a tiny droplet to each bug...or spread a thin layer on the bug or plant. The micron-sized drops from Sonic homogenizers will get more bugs "plastered" with more droplets from the same amount of insecticide than ever before.

Sonic Homogenizers develop and use all the energy right in the liquids with only 1/6 to 1/10 the power, and at a fraction of the first cost, of conventional equipment... maintenance-negligible.

The Dispersonic
...abrasive emulsions

Other Models
MINISONIC
...for small batches
SANISONIC
...meets sanitary requirements
AUTOSONIC
...continuous supply
RAPISONIC
...production homogenizer

Sonic homogenizers can give you a superior emulsion, too. Send for technical bulletin

Sonic
SONIC ENGINEERING CORPORATION
146 Selleck Street, Stamford, Conn.

LITERATURE . . .

Scale Feeders & Meters.....You can feed any free-flowing solid in batch or continuous blending operations . . . as little as 3 lbs. per minute; as much as 3000 with Merchen equip.
188a * Wallace & Tiernan Inc.

Surface Pyrometers.....are light weight, portable instruments. Bulletin 194-SA contains 33 illustrations and information on the many applications.
TR212 * Cambridge Instrument Co., Inc.

Temperature Controls.....Condensed catalog of temperature controls and allied equipment for industrial heating and refrigeration application available on request.
205A Partlow Corp.

Viscosity Determination.....Data sheet lists available reprints of technical papers on viscosity determination and control. Also lists several new books available.
205B Brookfield Engineering

Pipe, Fitting, Valves

Acid Hose.....has a cover of tough abrasion & acid resistant rubber. Hose ends are rubber sealed. It remains flexible even when cold, & is resistant to weathering.
83 * Acme Hamilton Mfg. Corp.

Hose.....Fluoroflex-T is completely inert to virtually all known chemical and corrosive solutions, solvents and gases to 500 F. More data available.
26 * Resistoflex Corp.

Fittings.....Catalog covering the complete line of stainless steel, forged steel and forged alloy steel fittings is now available to you upon request.
171 *Camco Fittings, Inc.

Flexible Connectors.....Dampen vibration, compensate for misalignment, permit offset movement, absorb expansion & handle most flexing applications. Fact-filled data sheet.
B223 * Allied Metal Hose Co.

Pipe.....Saran Lined Pipe, fittings, valves & pumps are available for systems operating from vacuum to 300 psi, from below zero to 200 F. Information available.
98 * The Dow Chem. Co.

Pipe & Fittings.....New technical brochure covers PVC rigid plastic pipe & fittings. Ideal for more efficient, economical & corrosion-free systems.
200 * Mueller Brass Co.

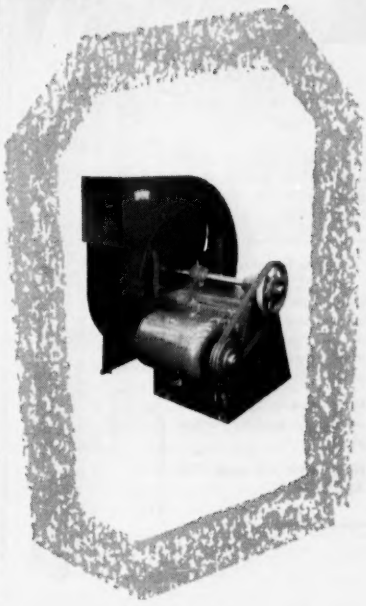
Pipe, PVC.....comes in sizes from ½ inch to 14 inches in diameter, & in schedules A, 40, 80 & 120. Two types are available: Normal Impact and High Impact. Bul. No. 24.
187 * U. S. Steel, National Tube Div.

Piping.....Technical data card contains the dimensions and weights per foot of pipe in sizes ⅛ through 36 in. for all schedules. Copies are available without charge.
205C Babcock & Wilcox

Plastic Pipe....."Questions and Answers about Rigid Plastic Pipe Made of ABS Plastics" is the title of a new folder providing basic performance and installation facts.
205D Marbon Chemical Div.

* From advertisement, this issue

NEED A PROCESS FAN?



READILY AVAILABLE:

WESTINGHOUSE RUGGED, VERSATILE FANS for handling air, gas, fumes, vapors in industrial processes . . . also in a variety of types for ventilation and materials handling.

Call your nearest Sturtevant Division Sales Engineer—or write Westinghouse Electric Corporation, Hyde Park, Boston 36, Massachusetts.

J-80681

YOU CAN BE SURE...IF IT'S
Westinghouse

Plants at Hyde Park, Massachusetts; LaSalle, Illinois; Berkeley, California.

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV MONDAYS

New Improved JERGUSON Gage Illuminator

gives up to 3 times the illumination

Low cost explosion-proof lighting of entire gage glass with no glare or blind spots

New Features:

Simplified Relamping . . . loosen one thumb screw to lift out cover and glass housing in one piece.

New Safety Chain prevents accidental dropping.

Now both UL and CSA Approved.

Easily mounted on back of Transparent Gage.

The New Jerguson EPL-56 Illuminator gives three times the illumination (and 3 times the bulb life) . . . a bright, evenly diffused light over the entire length of gage glass, thus enabling you to see the liquid level clearly and easily under all conditions. Relamping is simplified: one turn of the thumb screw and you lift out cover and glass housing in one piece.

Jerguson Illuminators incorporate the principle of solid wedge lighting. Illumination from a single bulb is reflected from the angular surface of the plastic wedge and is evenly diffused through the transparent gage glass.

Jerguson Illuminators are UL approved and are built in accordance with their Standard for Electric Lighting Fixtures for use in hazardous locations for Class 1, Group D Services. They are made in a variety of sizes.

Write for Data Unit on Process Gage Illuminators.

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY

100 Adams Street, Burlington, Mass.

Offices in Major Cities

Jerguson Tress Gage & Valve Co., Ltd., London, Eng.
Pétrole Service, Paris, France

LITERATURE . . .

Plastic Piping.....Handbook of plastic piping systems contains information on types of plastics, coupling methods, standards, corrosion effects of 280 chemicals, etc.
206A Chemtrol

PVC Valves & Fittings.....Line of rigid unplasticized, PVC valves and fittings is designed to solve tough corrosion and contamination problems. Write for bulletin.
206B Walworth Co.

TeeLet.....available in sizes from ⅛ to 1½" IPS. TeeLets are fully machined from forging quality solid steel bars & adapt to run-pipe sizes to 36". Details.
208 * H. K. Porter Co., Inc.

Tubing.....Lectrosonic designed to meet need of petrochemical industry for electric resistance welded carbon steel that is easily workable, strong, etc. Bul. TB-431.
108 * Babcock & Wilcox Co.

Tubing, Stainless Steel.....Small tubing drawn from PH 15-7 Mo, a preci-stainless steel possessing good mechanical properties at high temperatures is topic of SA 120.
206C Superior Tube Co.

Valve.....The air-cushioned Channel Valve is a combination of several small valves. Information about compressors for any service from ½ to 7500 hp is available.
59 * Ingersoll-Rand

Valve Control.....Complete information including prices and other data on Electrodyne automatic valve controls can be furnished promptly on request.
1 * Hupp Aviation Co.

Valve, Gate.....handles pressures of 800 lbs. at 850 F., and 2000 lbs. at 100 F. easily and safely. Rolled-in Seat Rings can't work loose. Literature.
49 * The Lunkenheimer Co.

Valve Sizing & Capacity Charts.....A comprehensive booklet contains charts obtained from thousands of actual lab flow tests for all body types & inner valve styles. #AL-8.
20-21 * Fisher Governor Co.

Valves.....Butterfly valves feature uniform control in all position & fast regulation & closure. Information on Rotovalves & butterfly, wafer & ball valves available.
198 * Allis-Chalmers, Hydraulic Div.

Valves.....Floating-Stem valves offer advantages such as; no backlash, preloading construction, etc. Offer choice of lower stem materials. Details in Bul. 5152-A.
46 * Autoclave Engineers, Inc.

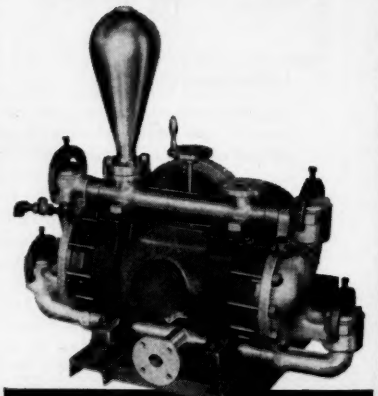
Valves.....come in fifteen sizes, designed to meet over 300 variations in installation requirements. New booklet CE-89 contains additional information.
172 * Durabla Mfg. Co.

Valves.....New Gate & Glove valves are available in ¼" thru 2" sizes & in both socket weld & screw ends. Feature extra deep stuffing box for long packing life. Literature.
112 * Henry Vogt Machine Co.

Valves, Coated.....Complete details, specifications and application data on the new coated valves. Now available with K-51 & Kanigen coatings.
43 * Rockwell Mfg. Co.

* From advertisement, this issue

NEW FEATURES INCREASE SERVICE LIFE



the NEW **SHRIVER DIAPHRAGM PUMP** *for those* **"TOUGH" MATERIALS**

- Simplified drive and diaphragm support mechanism increase operating life and facilitate maintenance.
- Complete diaphragm support mechanism may be removed as a unit, without disturbing existing piping.
- Liquid ends may be removed easily for inspection and cleaning.
- Slurry blow-off protects pump in event of diaphragm failure in operation. Slurry cannot affect working mechanism.
- Adjustable stroke—optional—available for varying pump capacity; without need for expensive variable speed drive.
- Pumps at discharge pressures to 100 psi, lift of 10′ of water for long periods, 15′ to 18′ for short periods.

Learn why this easy-to-clean, simple-to-maintain pump is right for your corrosive, abrasive, viscous, thick, heavy, quick-settling or sensitive fluids. Write for Bulletin 143.

T. SHRIVER & CO., Inc.

802 Hamilton St., Harrison, N. J.

Sales representatives in Atlanta, Buffalo, Chicago, Detroit, Houston, Los Angeles, St. Louis, San Francisco, Montreal, Toronto, Mexico City.

FILTER TIPS
by E.D. FILPAPER
WE'RE HAVING TROUBLE WITH FILTER PAPER DELIVERIES
WELL, DELIVERY IS NO PROBLEM FOR EATON-DIKEMAN
BUT YOU SEE, THIS IS A HORIZONTAL PLATE FILTER
E-D STANDARD GRADES AND SIZES OF CIRCLES ARE IMMEDIATELY AVAILABLE FOR THIS FILTER
BUT WHAT ABOUT COST
OUR PRICES ARE COMPETITIVE ...AND FREQUENTLY, LESS EXPENSIVE PAPERS CAN BE USED
THAT'S WONDERFUL, HOW DO YOU PEOPLE DO IT
AFTER ALL, WE'VE SPECIALIZED IN FILTER PAPERS FOR 70 YEARS
For more information, and FREE samples of E-D Filter Papers, write to
THE EATON-DIKEMAN CO.
Filtertown
Mt. Holly Springs, Pa.
"First with filter paper exclusively"

LITERATURE . . .

Valves, Diaphragm.....give dependable performance for vacuums down to 0.1 micron . . . with leak rates of less than 0.1 micron cubic ft/hr. Further facts available.
38 * Grinnell Co., Inc.

Valves, Lubricated Plug.....with stem-sealed self-freeing plug are outlined in Reference Book 39-Section 1. Contains illustrations, specifications & diagrams on all types.
207A Homestead Valve Mfg. Co.

Process Equipment

Airlock Feeders.....Bulletin P58 "How to Select A Rotary Airlock Feeder" is now available on request. Airlocks solve many processing problems.
B222 * Prater Pulverizer Co.

Blenders, Rotary.....available in nine standard models with capacities to 900 cu. ft. Feature self-cleaning, dust-sealed drum. More information on Blenders in Bul. 080B.
193 * Sturtevant Mill Co.

Chlorinators.....V-notch chlorinators controlled chlorination saves water & lowers treatment costs. You get maximum water value & use . . . even reuse. Details.
188b * Wallace & Tiernan Inc.

Dryers.....Denver Dryers for the Chemical Process Industries are described in Bulletin No. D4-B4. Sizes to 8' x 60' and larger are available.
168e * Denver Equipment Co.

Dryers.....Technical literature on prepackaged vacuum tumble dryers available. Also details on the pretesting facilities that are at your disposal.
54-55 * Patterson Kelley Co., Inc.

Dryers, Rotary Vacuum.....Blade clearance is adjustable down to ⅛ inch. Advisory & Engineering Service is available to help you solve drying problems. Information.
110 * F. J. Stokes Corp.

Electron-Beam Processing.....Handbook entitled "High Voltage Electron—Beam Processing" gives information on subject and specifications of manufacturer's line.
207B High Voltage Engineering

Electronic Air Cleaner.....Bulletin describes the Model B Rollotron electronic air cleaner. Details of operation, equipment drawings and specifications included.
207C American Air Filter

Evaporators.....for processing in the paper, aluminum, sugar & other chemical fields. Facts, figures & case histories of exports who have chosen this equipment, offered.
203 *Goslin-Birmingham Mfg. Co., Inc.

Filter.....Horizontal tilting pan vacuum filter permits up to six counter current washing steps. Information on capacity, construction & cost available.
2 *Bird Machine Co.

Filter.....Model MCR-S filter is completely automated for continuous operation unattended. Capacities up to 1000 sq. ft. of filtering surface. Details.
97 *Sparkler Mfg. Co.

* From advertisement, this issue

Plastic Steel® saved over $1000... plus days of downtime for MARRINER

A broken centrifuge at Marriner Combing Company stopped production on an important order. PLASTIC STEEL was used for on-the-spot repairs and the machine was back in operation within an hour at a cost of less than $5.00. Using conventional repair methods would involve several days and cost over $1000.

Hundreds of companies have saved time and money by repairing worn machine parts, cracked castings, leaking hydraulic systems and tanks, rebuilding worn pumps or valves, etc., with PLASTIC STEEL®.

PLASTIC STEEL® and other Devcon products are used for making jigs, fixtures, metal-forming dies, plastic and rubber molds, foundry patterns and core boxes, and other industrial tools.

PLASTIC STEEL® — as easy to use as modeling clay — hardens to steel-like strength in 2 hours . . . can be machined with regular tools. Bonds all metals, wood, glass, concrete, etc. to itself or each other. Extremely high tensile, compression, impact strength — excellent chemical resistance.

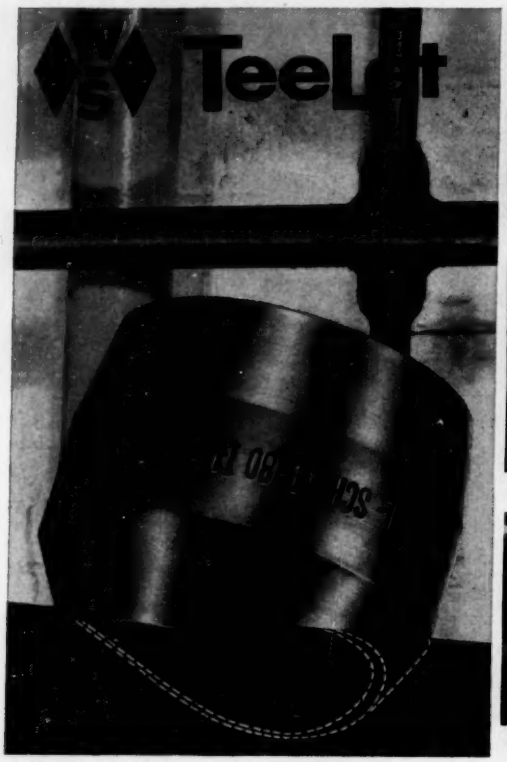
Find out how PLASTIC STEEL® and other Devcon products can save time, cut maintenance costs and speed production in your plant — write for FREE bulletin today.

Distributed nationally by leading industrial suppliers

DEVCON CORPORATION

134 ENDICOTT STREET, DANVERS, MASS.

FOR ⅛ TO 1½ INCH BRANCH CONNECTIONS



MARK

CUT

WELD

NEW W-S TeeLet SLASHES TEE COSTS 50% OR MORE!

The new W-S TeeLet replaces conventional Tees of cast or malleable iron, welded or forged steel . . . requires fewer stock sizes. Available in sizes from ⅛ to 1½" IPS, TeeLets are fully machined from forging quality solid steel bars and adapt to run-pipe sizes to 36". They require no additional joint strength calculations for any ASTM A-53 or A-106 Grade B run-pipe of Schedule 40 or 80.

What about cost? A size-by-size comparison with conventional Tees shows TeeLets average less than 50 per cent of the cost you now pay. A W-S TeeLet, with screwed, socket-weld or butt-weld ends, requires no shaping, fitting, beveling or extra alignment. You can connect to the run-pipe at any point. Short heights mean easy inspection of the attachment weld or back-weld, if desired.

A W-S TeeLet costs less to buy, less to install than anything you can buy or make. For complete information, prices, and names of distributors, write: *Forge and Fittings Division, H. K. Porter Company, Inc., Box 95, Roselle, N. J.*

FORGE AND PORTER FITTINGS DIVISION

H.K. PORTER COMPANY, INC.

PORTER SERVES INDUSTRY: with Rubber and Friction Products—THERMOID DIVISION; Electrical Equipment—DELTA-STAR ELECTRIC DIVISION, NATIONAL ELECTRIC DIVISION; Copper and Alloys—RIVERSIDE-ALLOY METAL DIVISION; Refractories—REFRACTORIES DIVISION; Electric Furnace Steel—CONNORS STEEL DIVISION, VULCAN-KIDD STEEL DIVISION; Fabricated Products—DISSTON DIVISION, FORGE AND FITTINGS DIVISION, LESCHEN WIRE ROPE DIVISION, MOULDINGS DIVISION, H. K. PORTER COMPANY de MEXICO, S. A.; and in Canada, Refractories, "Disston" Tools, "Federal" Wires and Cables, "Nepcoduct" Systems—H. K. PORTER COMPANY (CANADA) LTD.

LITERATURE . . .

Filter Elements Catalog BFD-48 describes nine basic filter element materials for a wide variety of air, gas and liquid filtering requirements. Photographs.
208A Bendix Filter Div.

Filter Paper.....Impregnating kraft paper pulp with 2 to 5% of neoprene before the filter sheet is formed increase dry and wet tensile strength. Neotone bulletin.
208B National Filter Media

Filters, Disc.....Agitator-type gives high filter capacity, lower moisture content & more uniform, dryer filter cake. Sizes to 9' dia. x 12 Disc. Bul. No. F9-B5.
168a *Denver Equip. Co.

Filter, Drum.....available in sizes to 6' diameter x 8' long. Additional information contained in Bulletin No. FG-BI which is now available on request.
168d *Denver Equipment Co.

Filters.....Complete Catalog includes detailed information of Plate-Shifters, Closing Devices and other labor-saving accessories for your filtration problems.
183 *D. R. Sperry & Co.

Filtration.....for help with your filtration problems, the new brochure "New Roles for Filtration" is just off the press. Brochure available on request.
R 204 *Purolator Products, Inc.

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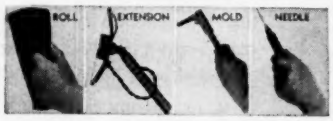

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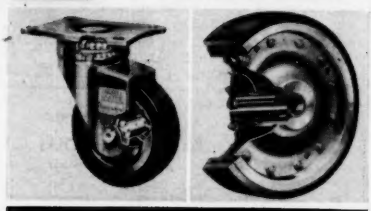

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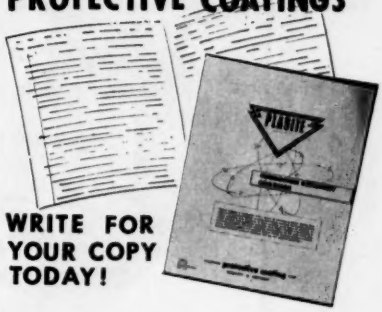
Pumps, High Pressure.....Multi-Stage are ideal for boiler feed & other applications. Operate against heads as high as 1500 ft., in capacities to 900 gpm. Bul. 980-D.
30b *Buffalo Forge Co.

Pumps, Non-Clogging.....Diagonally Split-Shell pumps are specially designed for moving high consistency liquids. Complete details in Bulletin 953-K.
30c *Buffalo Forge Co.

* From advertisement, this issue

Simplify
YOUR SELECTION OF PROTECTIVE COATINGS



WRITE FOR YOUR COPY TODAY!

PROVEN IN THE PROCESS INDUSTRIES
- STEEL TANK LINING
- CONCRETE TANK LINING
- PROTECTION OF STRUCTURAL STEEL, FUME DUCTS AND EQUIPMENT
- CONCRETE FLOORS
- TANK CARS

FOR IMMERSION SERVICE
FOR HEAVY DUTY MAINTENANCE SERVICE

COLD SET COATINGS
HEAVY BUILD using standard spray or brush methods.
WIDE CHEMICAL RESISTANCE to acids, caustic solvents, salts, de-ionized water, and aqueous solutions.
HIGH TEMPERATURE RESISTANCE not affected by thermal shock.
AIR DRY field applications.
EXCELLENT BOND — No Primers on white metal blasted surface.

OTHER PLASITE PRODUCTS INCLUDE: CAULKING COMPOUNDS
PRIMERS
BAKING COATINGS

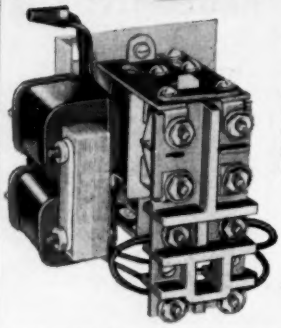
WISCONSIN protective coating COMPANY GREEN BAY, WIS.
REPRESENTED IN PRINCIPAL INDUSTRIAL AREAS

PLASITE

WARRICK Floatless Electrode Type

LIQUID LEVEL CONTROLS . . .

give you all these advantages!



No moving parts in the liquid • Easy to install • No adjustments necessary • Unaffected by acids or caustics • Unaffected by pressure or temperature • Standard 2&3 pole units listed by U/L

Write for 32-page Catalog which gives complete specifications

Two pole control shown at left

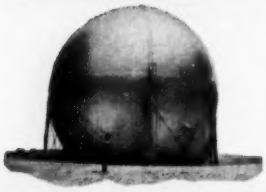
YOU CAN USE OUR CONTROLS FOR:

- Single & Multiple pumps
- Motor & solenoid valves
- High & low cutoffs & alarms
- Condensate contamination
- Storage tanks
- Volumetric Metering
- Waste sumps

Special controls to custom requirements

CHARLES F. WARRICK CO.

1964 W. Eleven Mile Road, Berkley, Michigan
Dept. 12 Telephone JOrdan 4-6667



HAMMOND TANKS

FOR LIQUIDS AND GASES

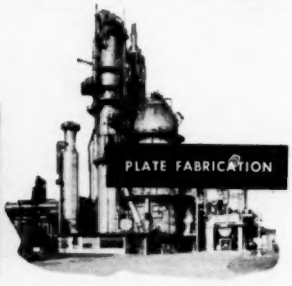
SPHERES · DIALIFT SYSTEM
DIAFLOTE TANK · VAPOR-LIFT SYSTEM
FLOATING ROOF · PLASTIC COVER

STEEL PLATE · STAINLESS STEEL · STAINLESS CLAD PLATES · T-1 STEEL AND OTHER STEEL ALLOYS · NICKEL-CLAD · ALUMINUM · ETC.

FIELD ERECTED TANKS AND VESSELS FOR LIQUIDS, GASSES, VAPORS AND STORAGE OF DRY MATERIALS

HAMMOND IRON WORKS

Sales Offices
744 BROAD STREET, NEWARK 2, N.J.
Offices and Plants
WARREN, BRISTOL and PITTSBURGH, PA.
PROVO, UTAH · CASPER, WYO. · BIRMINGHAM, ALA.



LITERATURE . . .

Rotary Compressors & Vacuum Pumps.....handle air and gases from 30 to 3300 cfm at pressures to 125 lb. gage. Vibration free, can be installed anywhere. Lit.
144b *Fuller Co.

Vacuum Blowers.....New line designed to handle capacities ranging from 30 CFM to 1,000 CFM. Specification sheet on new series & Bul. VP-158 covers larger units.
157 *Roots-Connersville Blower

Services & Miscellaneous

Abstracting Service.....supplies, at a charge, technical abstracts on drugs, cosmetics, toiletries, foods, plastics, paints and advertising. On index cards.
33-34r *U. S. Industrial Chemicals Co.

Alcohol Regulations.....As of July 1, 1959 a carrier permit is no longer required to transport tax-free, specially denatured and undenatured alcohol, and tax-free distilled spirits.
33-34e *U. S. Industrial Chemicals Co.

Booklet of Conversion Tables.....for metric & U. S. customary units of length, weight & volume can now be purchased. Contains conversions: mm-in., m-yd., etc. No. 1504.
33-34j *U. S. Industrial Chemicals Co.

Casters & Wheels.....with a wide choice of treads suited to all types of floors. Manual describes over 4000 types of casters and wheels that are available.
L213 *Darnell Corp.

Drafting Equipment.....New products and improvements in established lines is topic of catalog on wood and steel filing systems for blueprints and drawings.
214A Stacor Equipment

Drying System.....for processing chemicals, foods, pharmaceuticals, tobacco, synthetic rubber, textile fibers, veneers, leather, ceramics, etc. Bul. 443.
41 *Proctor & Schwartz, Inc.

Industrial Glassware.....Full information on Vycor brand glass, which withstands high temperatures and drastic thermal shock is given in a new 8-page bulletin.
214B Corning Glass Works

Iron Equipment.....Catalog A-9 contains complete information on blinds, spacer rings, temporary & line strainers & pivot flanges. Available on request.
BL212 *The Mack Iron Works Co.

Sulfur Recovery Plants.....Economical recovery of sulfur from hydrogen sulfide, and simultaneous alleviation of air pollution, are described in new booklet.
214C Girdler Construction

Tables and Formulas....."Convenient Tables and Formulas" includes 120 pages of information summarizing electrical data, heat transfer, measurements and other subjects.
214D Westinghouse Electric

Tanks.....Folder contains information on water and effluent treatment tanks. Units are steel-reinforced concrete structures faced on both sides with vitrified tile.
214E Stebbins Engineering

* From advertisement, this issue

PROFESSIONAL SERVICES

ARIES ASSOCIATES, INC.
Consultants to the Chemical Industries
New Products and Processes
New Product Development
Design & Initial Operation of Complete Plants
Process Analysis—Market Research
COMPLETE TECHNICAL & ECONOMIC SERVICES
225 Greenwich Ave. DA 5-2236 Stamford, Conn.

CARL DEMRICK
Technical Translations
Send for Circular
53 So. Broadway Yonkers, N. Y.

CHAS. T. MAIN, INC.
Engineers
Industrial plants
Reports Design Construction Supervision
Boston, Massachusetts Charlotte, North Carolina

THE J. G. WHITE ENGINEERING CORPORATION
Design Construction - Reports - Appraisals
80 Broad Street, New York 4

ADDRESS BOX NO. REPLIES TO: Box. No. Classified Adv. Div. of this publication. Send to office nearest you.
NEW YORK 36: P. O. BOX 12
CHICAGO 11: 520 N. Michigan Ave.
SAN FRANCISCO 5: 68 Post St.

EMPLOYMENT SERVICES

Better Positions—$6,000 to $50,000. Want a substantial salary increase more opportunity or different location? This national 48 year old service connects you with best openings. You pay us only nominal fee for negotiations; this we refund when employer pays placement fee. Present position protected. In complete confidence, write for particulars. R. W. Bixby, Inc., 553 Brisbane Bldg., Buffalo 3, N. Y.

POSITION WANTED

U. S. graduate chemical engineering, 28 years old, speaks French, German, experience consulting, management, Europe, Middle East. Working presently with international food manufacturer (Switzerland) seeks interesting U. S. position: consulting, technical sales. PW-2176, Chemical Engineering.

SELLING OPPORTUNITY WANTED

Aggressive Agent—desires additional process control components suitable CPI, pharmaceuticals, food industries. Metropolitan New York, Marshall Industrial Sales Co., 88-02 35th Avenue, Jackson Heights 72, N. Y.

CONTRACT WORK WANTED

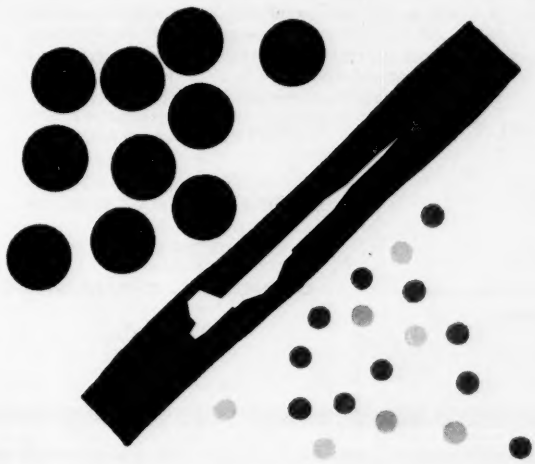
Small West-German Chemical Factory, with suitable free room for production (chemical, technical sector) wants to establish contact with a similar factory for the purpose of common production in the branch of Common European Market. CWW-2199, Chemical Engineering.

Don't forget

the box number when answering advertisements. It's the only way we can identify the advertiser to whom you are writing.

CLASSIFIED . . .
EMPLOYMENT OPPORTUNITIES

CE's nation-wide coverage brings you tips and information on current opportunities in job functions throughout the chemical process industries.



CATALYSIS SCIENTIST

The electro-chemistry laboratory at Lockheed Missiles and Space Division has an important opening at its new modern Sunnyvale, California facility for a scientist with strong background in the theory of catalysis. Advanced degree preferred and experience in developing catalysts required. Fundamental knowledge in solid state chemistry, physics or surface chemistry desired.

The Division's research programs reach far into the future and deal with unknown and stimulating environments.
FOR INFORMATION regarding this key position, write Mr. Dean Ing, Research and Development Staff, 962 W. El Camino Real, Sunnyvale, California.
U.S. citizenship required.

Lockheed

MISSILES AND SPACE DIVISION
Systems Manager for Navy POLARIS FBM, DISCOVERER Satellite, Army KINGFISHER, Air Force Q-5 and X-7
SUNNYVALE, CALIFORNIA

chemical engineers, mechanical engineers, and metallurgists

Rapid expansion of projects at General Atomic Division has created openings for qualified engineers, including senior positions. We are seeking people with experience in the development and design of mechanisms, boilers, and chemical process equipment, as well as men with experience in engineering analysis and in the development of new materials.

Some of the projects underway include the new High Temperature Gas-Cooled Graphite-Moderated Reactor (HTGR) for central station power; the Maritime Gas-Cooled Reactor (MGCR); controlled thermonuclear processes; research reactors; and nuclear space propulsion.

Please write to
Manager of Personnel, General Atomic,
P.O. Box 608-C, San Diego 12, California.

GENERAL ATOMIC
DIVISION OF
GENERAL DYNAMICS

GA GENERAL ATOMIC | GD GENERAL DYNAMICS

PATENT ATTORNEYS

THE CHEMSTRAND CORPORATION, a ten year old, rapidly expanding company—already a leader in the chemical textile fiber field—is seeking attorneys for patent and legal problem work associated with new product and process development. Law degree from an accredited institution and a minimum of two years experience in patent procedures preferably in the chemical field required. Degree in science or engineering desirable. Salary commensurate with experience. Position located at Chemstrand's corporate headquarters in Decatur, Alabama.

Send resume including salary information to:

Technical Personnel Manager
The Chemstrand Corporation
Box P-7
Decatur, Alabama

CHEMIST—CHEM. ENG.

Ph.D. or M.S., exper. activated carbon. Under 35. Salary open. M.S., min. 2 yrs high polymer exper. Under 35. To $12,000. Fee paid both positions. Send resume.

Engineering Dept.
James Pair Personnel Service
520-533 Forsyth Bldg. Atlanta 3, Georgia

SYNTHETIC FIBRES
$7,000 - $12,000

Staffing Modern plant. Vital work in a new fibre process creating positions for promotable men in research or development and process engineering. Chem or mech eng. future promising. Fees paid.

MONARCH PERSONNEL
28 E. Jackson Blvd. Chicago 4, Illinois

Your inquiry will have Special Value

If you mention this magazine, when writing advertisers. Naturally, the publisher will appreciate it . . . but, more important, it will identify you as one of the men the advertiser wants to reach with this message . . . and help to make possible enlarged future service to you as a reader.

SEARCHLIGHT SECTION

WIRE US COLLECT!

BIRD STAINLESS CENTRIFUGE
40" x 60" continuous with 50 HP motor. All 304 stainless contact parts. Used only 500 hours.

ME MACHINERY AND EQUIPMENT CO.
123 Townsend St. · San Francisco 7, Calif.

Searchlight Equipment Locating Service

NO CHARGE OR OBLIGATION

This service is aimed at helping you, the reader of "SEARCHLIGHT", to locate Surplus new and used equipment not currently advertised. (This service is for USER-BUYERS only.)

How to use: Check the dealer ads to see if what you want is not currently advertised. If not, send us the specifications of the equipment wanted on the coupon below, or on your own company letterhead to:

Searchlight Equipment Locating Service
Classified Advertising Division
Chemical Engineering
P.O. Box 12, N.Y. 36, N.Y.

Your requirements will be brought promptly to the attention of the equipment dealers advertising in this section. You will receive replies directly from them.

Searchlight Equipment
Locating Service
Classified Advertising Division
CHEMICAL ENGINEERING
P. O. Box 12, N. Y. 36, N. Y.

Please help us locate the following:

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NAME .....
TITLE .....
COMPANY .....
STREET .....
CITY .....ZONE .....
STATE 8/10/59

FIRST CLASS EQUIPMENT from Your FIRST Source!

SPOTLIGHT SPECIALS

Type 316 Stainless Reactors 1000, 2000 and 3500 gal.

Blaw Knox Conical Blender 300 cu. ft. 9'6" diam.

Pfaudler Glass Lined Reactors all sizes up to 1000 gal.

Mojonnier Stainless Vac. Pans Sizes 3' x 10' and 6' x 12'

Proctor & Schwartz Apron Type Dryers; 8' x 34½'; 5 sections

Bowen 4' S/S Spray Dryer; compl.

Double Drum Dryers to 40"x120"

New Unused F-B Rubber Mills 14" x 30" with Uni-Drives

Porcelain Lined Pebble Mills 36" x 42" to 8' x 8' complete

Mikro Pulverizers up to No. 4

Mikro S/S Atomizers, Nos. 5 & 6

Fitzpatrick Stainless Mills, Models D, K, and C, motorized

Pfaudler 6' Diam. Evaporators in Stainless or Glass Lined

Simpson Muller Type Batch Blenders, Lab. to 6' size

Baker Perkins Double Arm Jacketed Mixers to 300 gal.

Baker Perkins Ko-Kneaders Continuous Type K 300 gal.

Send for "First Facts"

FIRST MACHINERY CORP.
209-289 TENTH STREET, BROOKLYN 15, N. Y.
PARKING ON THE PREMISES
PHONE: STerling 8-4672 FMC

DIESEL ELEC. LOCOMOTIVES

3—New 25 Ton, 2 GE I Whitcomb.
3—23 Ton, 2-45 Ton Used Gen. Elec.
1—44 Ton, 1-80 Ton Used Gen. Elec.
1—100 Ton, Alco Used New 1955.
3—100 Ton, Gen. Motors, 600 HP Used.

PLANT EQUIPMENT

2—6' x 36" Hardinge Ball Mills
2—4' x 5' Allis-Chalmers Ball Mills
Nos. 56, 77 & 96 Marcy Mills
7' x 24' Allis-Chalmers Tube Mill
5' x 10' & 7' x 15' Rod Mills
9" x 21" Telsmith Jaw Crusher
14" x 28" New England Jaw Crusher
30" x 36" Traylor Type H Jaw Crusher
56" x 72" Traylor Style G Jaw Crusher
No. I Sturtevant Rotary Fine Reduction
2' Symons Standard Cone Crusher
4½' Symons Standard Cone Crusher
36" x 20' Ruggles Coles Class XF-I Rotary Dryer
#705—24 Link Belt Roto Louver Dryer
4' x 20' Rotary Dryer
5' x 30' Ruggles Coles Class XA-8 Rotary Dryer
9' x 160' Vulcan Rotary Kiln
42" x 18" Traylor Type AA Crushing Rolls
1—10 HP Stephen Adamson 3/60/220/440 Car Puller

R. C. STANHOPE, INC.
60 E. 42nd St. N. Y. 17, N. Y.
Tel. MU 2-3075

CLASSIFIED . . . EQUIPMENT SEARCHLIGHT

CE's Searchlight spots the big bargains in used, resale and rental equipment. Check this issue's listings—most complete in the field—for items you need now.

▶ **Coverage** — National Equipment and facilities—used, resale and rental—for the process industries. For sale, wanted, for rent.

▶ **Rates**—$21.75 per inch for all ads except on a contract basis; contract rates on request. Ad advertising inch is measured ⅞ in. vertically on a column; 3 columns, 30 in. per page. Ads acceptable only in display style.

▶ **Closing date** — Sept. 21 issue closes Aug. 18. Send all new ads to Chemical Engineering, Classified Adv. Division, P. O. Box 12, New York 36, N. Y.

COMPRESSORS
World's Best Rebuilts

27 CFM	3000 PSI Worth V4A3 & V4A3W
70 CFM	1500 PSI 9x8 Norwalk TDS3T
110 CFM	3000 PSI Ing. GC 50BW
138 CFM	100 PSI 7x7 Ing. Rand ESI
191 CFM	300 PSI 9-4¼x9 Ing.
238 CFM	100 PSI 9x9 Ing. ES Worth HB
242 CFM	125 PSI 8x7 Joy WG9
311 CFM	1500 PSI 10½-7½-3½x13 IR-ES3
465 CFM	100 PSI 12x11-IR-ES-I-Worth HB
496 CFM	Vac. 14x7 CP-T (3)
502 CFM	125 PSI 12x13 Worth HB, IR-ES
676 CFM	100 PSI 15-9¼x12 Worth. & IR
686 CFM	100 PSI 14x13 Ing. ES
1545 CFM	110 PSI 21/13x14 IR XRE
3135 CFM	Vac. 31x13 Ing. ES
7950 CFM	200 PSI 33-17¾x27 Ing. PRE24C

60'-600' portable—gas or diesel

AMERICAN AIR COMPRESSOR CORP.
North Bergen, N. J. UNion 5-4848

MACHINECRAFT

S. S. Reactor 1200 gal 200 lb pressure
Baker Perkins 150 gal 40 HP, 100 gal 50 HP both S.S. 2 arm jacketed vacuum hydr. tilt
Blaw-Knox 2 gal S.S. Autoclave 5000 lbs.
50 gal S.S. Autoclave 2000 lbs pressure
Vulcanizer 60" x 9' 125 lbs.
Sweetland #2 all stainless
Stainless steel Ball Mill
Aluminum Condenser 350 sq. feet
Aluminum Evaporator Calandria type, never used. 1300 sq. ft. tube area.
Proctor & Schwartz finned drum driers
Continuous Stripping column 2 X 13 Steel
S.S. Centrifugals 40" bottom discharge, glass
Calenders 3 Roll 42" X 18"; 6 Roll 12" X 9"
Hydraulic Pumps. Motors.

LOUIS SUSSMAN, INC.
800 Wilson Ave. (East of Doremus)
Newark 5, N. J. Mi 2-7634

WANTED SURPLUS EQUIPMENT
SINGLE ITEMS OR ENTIRE PLANTS

FOR SALE

1—Baker Perkins 200 wc, cored dbl Sigma blades, jacketed, also internal pressure. Unidor type, size 17. DAM, very hvy duty.
1—75 gal Legion Kettle, all SS, Jacketed for 90 psi, 15 psi internal pressure, bottom outlet
1—Stokes Model R Tablet Press
2—Colton Model 5½ T Tablet Presses
3—Baker-Perkins 200 gal. wc Mixers
1—Baker-Perkins 7 gal. wc Mixer
Stainless Steel Kettles 20 to 200 gal. in Stock
2—J. H. Day Co., Series 80, 40" x 120" Roball Gyrating Screens w/Mtrs.

AARON EQUIPMENT CO. ALL PHONES GLadstone 1-1500
9370 Byron St., Schiller Park, Ill.

AUGUST SPECIALS

BP 100 gal. 4 side Jktd. Mixer Cored Sigma arms
Patterson-Kelley 40 cu. ft. Twin Cone Blender
Feinc S.S. 3'x1" Rotary Vac. Filter
Gruendler "BB" Hammermill, Whirlbeater
Pfaudler 1500 gal. Glass Closed Top Tank
Patterson 6'x5' Jktd. Ball Mill, ex. pf. mtr.
Gen. American 42" x 120" Twin Drum Dryer
Nash Hytor Vac. Pump #6, with 40 H.P. motor
Ribbon Blenders steel & SS, all sizes, new & used

WHAT HAVE YOU FOR SALE OR TRADE?
YOU CAN BANK ON

EQUIPMENT CLEARING HOUSE, Inc.
111 33rd Street Brooklyn 32, N. Y.
SOuth 8-4451—4452—8782

—PIPE—

500,000 ft 10¾" 40#
250,000 ft 8⅝" 28½#
All machine cleaned, straight. Plain end, coated. Strickley No. I. Pittsburgh Test. Lab. report furnished. Immediate delivery.

INDIANA-OHIO PIPE CO.
P. O. Box 323, Phone 34674, Decatur Ind.

BEST BUY

NEW WESTINGHOUSE MOTORS
In Our Stock
85—Direct Drive.—20 HP through 125 HP 900, 1200 and 1800 RPM
195—Gear Motors—1 HP through 60 HP Speeds, 30 RPM through 200 RPM
SPECIAL LOW PRICES
Wire or phone collect—GA 1-1380

ME MACHINERY AND EQUIPMENT CO.
123 Townsend St. - San Francisco 7, Calif.

WANTED

BAKER PERKINS heavy duty jacketed, double arm, sigma blade mixers.

HAROLD SIBNER
43 34th St. BROOKLYN 32, N. Y.

"OUTSTANDING VALUES"

4—Schmidt 5'6" x 22' Tube Mills. Silica brick lined. 100 HP

1—New Sturtevant 10'8" x 25' Rotary Blender. 50 TEFC motor

1—New Sparkler 18-D-8, S.S. Jacketed Filter. Complete with scavenger plate

2—Fitzpatrick Model D. S.S. comminuting machines. 10 HP motor

1—Steel Fractionating Tower. 42" x 70' high, 20 Trays on 24" centers

1—Dings Magnetic Separator, "Crockett Type", 12" wide 8 pole

2—Raymond Roller Mills, 4-Roller Hi-Side, Cyclone, Separator & Collectors

1—Oliver 8' x 10' Precoat, Rot. cont. Vacuum Precoat. w/Vacuum Pump

For immediate quote, wire or phone collect—GA 1-1380

ME MACHINERY AND EQUIPMENT COMPANY
123 Townsend St. · San Francisco 7, California

SAVE ON GOOD USED MACHINERY

Centrifugals: 12", 30", 40" & 48".
Centrifuges: Sharples #5 & #6 Stainless.
Dryers: Albright Nell 4x9 Atmos. Drum Buffalo Vac. Drum Dryer 24"x20". Vac. Shelf, Atmos. & Rotary Dryers.
Filters: Vallez 49 S. S. covered leaves. #2 Sweetland 12 Stainless Leaves.
Filter Presses: 6" to 36" Iron & Wood.
Kettles: S.S. Jack. 20 to 500 gals. Dopp 350 gal. cast iron Jack. Vacuum. Devine Impreg. Units 30" & 36" dia. Steel, Alum. & Copper 5 to 2,000 gals.
Mills: Raymond #00, 30 HP. & #0000. Mikro Pulverizers #4, 2, 1, & Bantam.
Hammer Mills & Pulverizers 3 to 50 HP. Ball & Jewell #2 Rotary Cutters & others Spr. Waldron Stainless spike crusher. Pebble, Jar & Ball Mills, Lab. to 6' x 8. 3 Roll, 9" x 32", 12 x 30", 16" x 40". Lehman 4 Roll W.C. 12" x 36" Steel. Colloid Mills 1½ HP. & up.
Mixers: Baker Perkins Jack. 100 gals. Day Imperial 30, 75 & 150 gals. Change Can Mixers 8, 15, 40 gals. Day Jumbo 700 gal. horiz. mixer. Sturtev. 1 ton Drum Blender 10 HP. Blystone 3000# horiz. spiral mixer. Dry Spiral Mixers 50 to 3000#. Lancaster 6' dia. 25 HP. & #1, 3 HP. Blakeslee 80 qt. vertical mixer.
Pumps: Stokes etc. Vac. 10 to 500 CFM. Gould 75 HP. Centrifugal 250 PSI.
Sifters: Day, Robinson etc.
Tablet Machines: Stokes RD 3 Rotary, also Single & Rotary ½" to 3". Plastic Rubber Machy. Hydr. Presses.

Partial listings. Write for Bulletins.

STEIN EQUIPT. CO.
107-8th St., Brooklyn, 15, N. Y.
Sterling 8-1944

LOEB OFFERINGS

Autoclave: 50 gal. Struthers Wells, st. st.
Centrifugal: Tolhurst 20" st. steel (New)
Clarifiers DeLaval and Sharples, st. steel.
Dewaterers: Davenport 3A, bronze hd. 3 hp.
Dryer: Devine 2 x 4' vac. drum, st. steel.
Dryers: Link-Belt Monotube of monel.
Filters: Elmco, Oliver, Sweetland, Alsop.
Homogenizer-Dispenser: Tri-Homo #10, #4.
Kettles: St. Steel, with and without ag. Dopp 150 gal. dbl. act. agitator.
Mills Micro Bantam, 21h and 24". Fits Comminuting model D, st. st. Day 14 x 30" type B hi-speed. Colloid, 3, 5, 20, 25 hp. Cog stain. steel, 10 hp.
Hammer: Williams, Jeffery, Prater, Ray.
Mixers: Dbl. and Sgl. arm sigma blade. Dry Powder, various sizes. Baker-Perkins size 17, 30 hp.
Mix-Muller Simpson Lab., Porto, #00.
Percolator: Pfaudler 54 x 42" st. st. jack.
Pumps: Rotary, gear, centrif., vacuum.
Reactor: Pfaudler 50, 1000 gal. gl. lined.
Rectifying Column: 16" x 30' Brighton.
Screens: Selectro 4 x 10', 3-deck.
Vacuum Pan: 42" Harris st. steel.

LOEB EQUIPMENT SUPPLY CO.
[illegible] CHICAGO 22, ILLINOIS

MILLS—Hammer—00 Sturtevant 10 HP, AKB Wms. 25 HP, 3W Mikro 30 HP, #2 Gruendler Supermaster 40 HP, #50 Raymond S/S Imp, AKBX Wms. 50 HP, 30 NF Wms. 100 HP, 36 x 52 Jeffrey 125 HP, SXT 14 Penna. 350 HP
MILLS—Colloid—1½" US 7½ HP, 2" B&S 20 HP, PA Robinson 5 HP, Sprout Waldron 2—40 HP motors
MILLS—Hardinge—Conical—4½ x 16 (10 HP) pebble, 4½ x 24 (25 HP) ball, 6' x 36" (60 HP) ball, 7' x 22" (75 HP) pebble, 8' x 36" (125 HP) ball, 8' x 48" (175 HP) ball, 10' x 48" (350 HP) ball
BIN—70 cu. yd. capacity Butler w/7 x 12 Bucket selvator, weigh hopper
CONVEYORS—18" x 16' Farquar troughing, 18" x 34' apron, 18" x 37' trough, Bucket elevators to your specs.
PACKERS—St. Regis 100LS (unused), 105FV w/scales, Pneumatic Scale Capper.
AUTOCLAVES—35 Gal. S/S jacketed, 150 Gal. steel jacketed/agitated
DRYERS—12' x 24' x 90" truck/tray, Steam—24" x 22', 33" x 18', 36" x 24', 44" x 25', 4' x 40', 5' x 40', 9' x 30' Rotary

YOUR BEST REBUILT MACHINERY SOURCE

LAWLER COMPANY
Durham Ave. Liberty 9-0245 Metuchen, N. J.

VALUES GALORE—PARTIAL LISTINGS

Shriver 36" Filter Press C.I. 46 Ch. 2" Cake.
Alum. Pl. & Fr. Press 36"—29 Ch. 1" Cake.
Stokes "F" & "R" Single Punch Presses.
Day D-10 Spiral Mixers 1000# Cap.
Abbe 2200# Spiral Mixer.
Day 20 Gal. Monel Jack. Sigma Blade Mixer.
B. P. Stainless Jack. Mixer 1 gal. Sigma Blades.
Fletcher 30" type 316 S.S. Sux. Style Extractor.
Horiz. Jack. Sterilizer 36" x 48" x 96".
Stokes Lab. Vac. Shelf Dryer 18" x 12".
Devine 6 Shelf Vac. Shelf Dryer 40" x 41".
Pfaudler G. L. Reactors 500 & 750 Gals.

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20 Towers 2'6" to 16' dia. x 20' to 145' up to 300 PSI
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22,500 CFM I.R. Turbo Blower 29.65 PSIA 2000 HP. Motor
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WRITE FOR CATALOGUE
REPRESENTATIVE ON PREMISES
Boston & Haven Sts., P.O. Box 5203
Baltimore 24, Md. DIckens 2-0224

SELECTED STOCK ITEMS

3—ROTARY KILNS, 11'x155'; 8'8"x70'; 8'x50'
3—ROTARY DRYERS, 6'x60'; 5'x45'; 38"x27'
2—STEAM TUBE DRYERS 6'x50' & 6'x25'
1—50 gal. S.S. Jktd., Agit., Reactor
3—ROTO LOUVRE DRYERS Link Belt steel 502-16, 705-24; stainless 604-24.
1—PFAUDLER 750 gal., glass lined, jacketed, agitated Reactor, 15 HP motor.
1—PFAUDLER 200 gal., G.L., jktd. agit.
1—B. & J. #1½ Rotary Cutter 30 HP XP.

SHARPLES C27 VAPORTITE SUPER-D-HYDRATOR 316 STAINLESS, 6 AUTOMATIC CYCLE TIMERS; SOLENOID, RINSE AND 3 WAY DIVERSION VALVES; 40HP X.P. MOTOR—SLIGHT USE—LIKE NEW

8—JEFFREY Hammer Mills, 15"x8"; 20"x12"; 24"x18" motor driven.
10—TYLER-HUMMER Screens, 4' x 6'; 4' x 8'
8—EVAPORATORS, 500 to 15,000 sq. ft.
1—HARDINGE 8' x 30" Conical Ball Mill.
2—FLETCHER 40" Steel Centrifugals, Susp.
1—FLETCHER 30" stainless Centrifugal, Susp. perforated basket, vaportite
2—OLIVER 5'3" x 3' Precoat Filters, 316 S.S.
2—KOMAREK-GREAVES 27" x 23" Briquetting Presses, Feeders & 75 HP motors.

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1—Bird 32" x 50' Cont. Cent. 316 S.S.
4—Sharples C20 Super-D-Hydrators, 316 S.S.
1—Sharples PN14 Super-D-Canters, 316 S.S.
1—AT&M 26" sus. Cent., perf. bskt., 316 S.S.
1—Oliver 8' x 8' Precoat rubber covered Rotary Vacuum Filter.
14—Sperry 36" and 42" plate & frame Filters, rubber covered, cast iron, aluminum and wood.
5—8' dia. x 24' rubber lined Crystallizers.

PULVERIZERS AND MILLS

2—Abbe 5' x 16' brick lined Mills.
3—30' dia. Stainless Steel Micronizers complete with Hoppers, Conveyors, etc.

KILNS AND DRYERS

1—Traylor 11' x 155' Rotary Kiln, 7/8" shell.
1—Renn. 6' x 60' Rotary Kiln, 5/8" shell.
1—Vulcan 8' x 50' Rotary Kiln, 5/8" shell.
1—Proctor & Schwartz 8' wide x 60' long Conveyor Dryer, Stainless steel Belt.

RUBBER LINED TANKS

7—3400 to 5000 gal. with Turbo Agitators.
5—8500 gal. Vertical Storage 8'6" x 16' x 8' cone
1—9000 gal. Vertical Storage.
1—13,000 gal. Horizontal Storage 8' x 35'.

STEEL TANKS

6—2000 to 5200 gal. with Turbo Agitators.
15—Storage Tanks: 3800; 6000; 9000; 10,000; 15,000; 47,000 gals.

MISCELLANEOUS

7—Dorr Thickeners: 16' dia. with Tanks.
1—Bemis 50# Bag Packer with Sewing Machine, Conveyor and Flattener.
80—LaBour, Durco, Worthite, Duriron and Stainless Steel Centrifugal Pumps 2" to 6" with motors.

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5—B & W 70,000# per hour Boilers, 500 psi.
1—I. R. Two Stage Compressor, type HHE2, 600 HP motor, 3170 cfm, 125 psi.
125—Heat Exchangers up to 4600 sq. ft.
100—Pressure Vessels, up to 12' x 110'.
200—Centrifugal Pumps with XP motor, up to 9000 gpm.
30—Towers, 2' to 10' dia.
75—Storage Tanks, 1000 to 80,000 barrels.
7—Hortonspheres, 5000 to 10,000 barrels.
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BUY BRILL

REACTORS—EVAPS—CONDS—TANKS

6—Struthers Wells 2000 gal. 316 S.S. jktd. agtd. Reactors.
2—Struthers Wells 1000 gal. 316 S.S. jktd. agtd. Reactors.
1—1000 gal. Pfaudler, Model R glass lined, jktd., agtd. Reactor.
1—500 gal. Walters, 304 S.S. jktd. agtd. Reactor.
1—550 sq. ft. Buflovak, Monel, single effect Evaporator.
1—250 sq. ft. Buflovak, 304 S.S. forced circulation Evaporator.
1—7500 gal. 316 S.S. Vert. Storage Tank, 7' x 25' 50 PSI.
1—750 gal. nickel clad Mixing Tank, 125# nickel coils.
1—3000 gal. Aluminum Vert. Tank. 6' x 18'.
1—4000 gal. Haveg Vert. Tank, 8' x 12'.
1—12,000 gal. horiz. steel Pressure Tank, 7'6" x 36', 200 PSI.
8—Stainless Heat Exchangers, 1220, 942, 786, 536, 396, 315, 250, 157 sq. ft.

CENTRIFUGALS

1—Bird 18" x 28" 316 S.S. Solid Bowl, Continuous.
1—Bird 18" x 28", steel, Solid Bowl, NEW, Continuous.
1—Bird 36" x 50", 347 S.S. Solid Bowl Continuous Centrifuge.
2—Sharples PY14, PN14, Super-S-Canters, 316 S.S.
1—Sharples H2 Nozzlejector, 15 HP, 304 S.S.
1—Bird 40" suspended, 347 S.S. perforated basket.
2—Sharples #16, 304 S.S., 3 HP motor.

FILTERS

1—Oliver 5'3" x 8' Steel Rotary Vacuum, vaporite housing.
1—Sparkler 332528 Filter, 150 sq. ft. 304 S.S.
1—Niagara 36H110 horizontal Filter, 110 sq. ft., 304 S.S.
1—Sparkler 33-S-17 Steel Filter, 92 sq. ft.
1—#12 Sweetland Filter, 48 leaves, 3" centers, 640 sq. ft.
2—#10 Sweetland Filters, 27 leaves, 4" centers, 250 sq. ft.

DRYERS

1—Devine Vacuum Shelf with 19—59" x 78" shelves.
1—Devine Vacuum Shelf with 10—40" x 43" shelves.
2—Devine 5' x 12', 4' x 9', Atmospheric, Single Drum.
1—Baker Perkins 5'6" x 6' Rotary Vacuum Dryer.
1—Buflovak 3' x 20' Rotary Vacuum Dryer, 316 S.S. Unused.
2—Louisville Rotary Steam Tube 6' x 25', 6' x 50'.
4—Rotary Dryers, 4' x 40', 6' x 50', 5'6" x 50'5" x 30".
3—Louisville 8' x 50' Stainless Steel lined Rotary Dryers.
1—Traylor 30" x 18' Stainless Steel Rotary Dryer.
2—Link Belt; 7'5" x 25" Monel 6'4" x 24' S.S. Louvre Dryers.

MIXERS

1—Baker Perkins #16TRM, 150 gal. jktd., Vac. 60 HP.
1—Baker Perkins 100 gal. jktd., Sigma Blades.
5—Day "Cincinnatus" double arm, 250 and 100 gal.
1—1500# Powder Mixers, 7½ HP XP motor.
2—Steel, jktd. Powder Mixers: 225 and 350 cu. ft.

MISCELLANEOUS

1—HPM 88 ton horizontal Steeping Press.
1—Ross, 6" x 14" Three Roll Mills.
3—Swenson Walker Continuous Crystallizers, 24" x 30' sections.
4—Rotex Sifters: 40" x 84", 60" x 84".
3—Robinson Gyratory Sifters, 30" x 104", Triple Deck.
8—Stokes DD2, DDST, T, "R" and "F" Tablet Presses.
10—Nash, Vac. Pumps: H6, L5, L3, TS7, #2, MD572.
25—Chloriment, Duriment and Duiron Centrifugal Pumps 1½" to 6".

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STOCK ITEMS

CENTRIFUGALS, BASKET

1—48" A.T.&M. Susp., T304 SS perf.

6—48" A.T.&M. Susp., T304 SS Solid basket, 40 HP, 1952.

1—40" Bird, susp. steel, imperf.
1—36" Tolhurst, bronze center-slung.
2—30" A.T.&M. susp., T304 SS.
1—30" Fletcher, underdriven, T304 SS.
1—26" Fletcher, underdriven, T316 SS.
1—26" Tolhurst, susp., steel perf.

MILLS

2—Raymond #5057 hi-side
1—Kennedy 4' x 8' rod mill, 50 HP
4—A-C 5' x 22' ball mills, 150 HP
1—Traylor 8' x 11' ball mill, 300 HP
1—Penna. non-clog swing hammermill, 400 HP, UNUSED
1—Hardinge 4'6" x 16" conical ball mill, 25 HP
3—Jaw Crushers: 36" x 15", 20" x 6", 18" x 9"
3—Ink or Paint Mills, 3-roll: 9" x 24", 6" x 14"

ROTARY KILNS—DRYERS

1—11' x 155' Traylor, ⅞" shell Kiln.
1—9' x 100' Vulcan, ⅝" shell Kiln.
1—8' x 115' ⅝" shell, 2-tire Kiln.
2—7'6" x 100' ½" shell Kilns.
1—7'6" x 65' Kiln, ½" shell.
2—6' x 60' ⅝" shell Kilns.
1—4' x 24', 2-tire Kiln.
4—Hardinge 8'8" x 7' Dbl. shell dryers, #XA-18, welded, ½" shell.
1—7'6" x 65' dryer, ½" welded shell.
1—Allis-Chalmers 7' x 50' dryer.
1—6' x 50' Louisville dryer.
6—Steel dryers: 5'6" x 50', 4'9" x 32', 4'6" x 40', 4'6" x 32', 4' x 30', 3' x 15'.
2—Stainless dryers: 4'6" x 12', 3' x 10'.

TANKS

1—8000 gal. T304 SS, vert.
12—4500 gal. nickel-clad, vert. 125#.
1—3000 gal. alum., vert., open.
1—10,500 gal., T 304 SS, horiz., UNUSED, dished heads.
2—5700 gal., T304 SS, horiz., UNUSED.
4—Vacuum tanks w/coils, T304 SS: 3700, 3000, 2350, 1750 gal.
1—3400 gal., T304 SS, horiz.
1—2000 gal., T316 SS, hopper.
8—1750 gal., T304 SS, hoppers.
1—1400 gal., T316 SS, ASME, 175#.

24—SHAYLES #16 Super Centrifugals, Inconel bowls, stainless steel covers, 3hp TBFC motor.

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Type 316 Stainless Steel Equipment

CHEMICAL PLANT—ORANGE, TEXAS

TYPE 316 STAINLESS STEEL TANKS

1—17,650 gal. 9' dia. x 36' long, T316 SS, ¼" shell, ⅜" heads w/coil.
2—6,500 gal. 11' dia. x 7' high, T316 SS, 7/16" shell, ½" heads.
12—2,300 gal. 7' dia. x 8' high, T316 SS, ¼" shell, coils (some with agitator).
2—2,000 gal. 6'6" O.D. x 8' long, ¼" shell.
2—1,100 gal. 5'6" dia. x 6' high, T316 SS, w/coils, with agitator.
4—1,200 gal. 5' dia. x 7' high, dished top, 42" deep conical bottom (crystallizer tanks).
7—560 gal. 3'6" dia. x 7' high, ¼" dished top, 4' deep conical bottom.
55—Tanks and Pots from 10 gal. to 350 gal. sizes, vertical and horizontal, dished heads.

STAINLESS STEEL COLUMNS

1—108" Dia. Vulcan scrubber, 10 trays on 12" centers, 252—bubble caps per tray.
1—96" dia. x 13' high scrubber, 10 stainless steel trays on 12" centers, 276—caps.
2—96" dia. x 35' high bubble cap columns, 30 trays, 12" spacing, 272—caps per tray.
2—60" dia. x 13' high, Vulcan scrubbers, ¼" shell, 10 trays, 100—caps per tray.
1—48" dia. column, 25 trays, bubble caps, T304-ELC.
3—30" dia. packed columns, 25' high, T316 SS.
4—24" dia. bubble cap columns, 12 trays, T316 SS, 18" spacing—Vacuum.
2—20" dia. stainless steel columns, 25' & 30' high.

COPPER COLUMNS

1—72" dia. Vulcan bubble cap copper column, 46'10" high, 40—trays.—Vacuum.
2—48" dia. bubble cap copper columns, 25 & 40 trays, 31' & 45' high.—Vacuum.
2—42" dia. Vulcan stills, 56" high. (Evaporator bodys).
1—24" dia. column, 25'8½" long, 20 trays, bubble caps.

FILTERS—CRYSTALLIZERS

2—Sharples C-20 Super-D-Hydrators T316 SS.
3—18,000 gal. Aluminum Cone bottom tanks, 12' dia. x 31' O.A.H.
4—1200 gallon Crystallizers, T316 SS, 5' dia. x 7' high, dished top, conical bottom.
7—560 gal. Crystallizers, T316 SS, 3'6" dia. x 7" high, dished top, conical bottom.
3—Worthington 160 Ton steam jet refrigeration units.
1—Pneumatic Conveyor System, approx. 1150' 10" dia. Aluminum Pipe.

TYPE 316 STAINLESS STEEL KETTLES

3—3,500 gal. jacketed kettles, 7' dia. x 12' high, T316 SS. 11/32" shell, dished heads, 11 turns SS coil, two-speed agitator, 40/20 HP-1750/500 RPM.
1—2,500 gal. 6' dia. x 12' high, T316 SS, horiz. still kettle.
3—1,000 gal. 5'6" dia. x 6' high, T316 SS, int. coils, turbine agit.

CONDENSERS—HEAT EXCHANGERS—CALANDRIAS—COOLERS

1—1,450 sq. ft. condenser, stainless steel tubes, tube sheets, heads, and baffles.
1—1,200 sq. ft. condenser, stainless steel tube, steel shell.
14—750 & 800 sq. ft. stainless steel condensers, vertical, T316 SS tubes and heads.
9—Condensers, 356, 400, 410, and 550 sq. ft., T316 SS.
5—Calandrias, 140, 145, 150, 157, 250, 277 sq. ft., T316 SS.
11—Exchangers, 64, 70, 75, 80, 100 sq. ft., T316 SS.
12—Exchangers 20, 30, 47, 50 52, 54 sq. ft., T316 SS.
15—Cupro-Nickel & Copper exchangers, up to 1070 sq. ft.

MISCELLANEOUS EQUIPMENT

10,000—T316 SS pipe & tubing, 1", 2", 3", etc. up to 12".
2,000—Valves, T316 SS, up to 12".
1—Otis elec. freight elevator, 5000# @ 75 FPM.
40—Stainless steel pumps 1" to 6", 1 HP to 20 HP.
3—Steel columns: 48", 30", 20" dia.
2—St. St. bucket elevators, 62' and 45' high.
4—Stainless steel screw conveyors and chutes.
1—2,000 gal. aluminum tank, 6' dia. x 10' high, coils.
25—Stainless steel steam jet evactors and ejectors.
18—Separators, T316 SS, 22" x 8' overall depth, cone type.
1—Croll-Reynolds #21 jet vacuum air pump, capacity 50# per hour.

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1—Pfaudler type 316 SS, 150 gal. jacketed reactor, complete with impeller type agitator drive and baffle, 85# jacket pressure, 75# internal pressure.
2—Struthers Wells 500 gal. nickel jacketed reactors, complete with anchor type agitators, drives and motors.
1—Baker Perkins 5 gal. double arm jacketed sigma blade mixer, Size 8CE.
1—Patterson Type 347 SS jacketed vacuum sigma kneader master mixer, 500 gal. capacity.

AUTOCLAVES, KETTLES AND REACTORS

1—A. O. Smith SS jacketed 1000 gal. reactor
8—Alco type 316 SS jacketed reactors, 3000 gal. each, with agitators and drives
2—Struthers Wells type 316 SS jacketed reactors 3500 gal., complete with coils, agitators and drives
1—Steel & Alloy Tank Co. 225 gal. type 347 SS jacketed autoclave, 250# jacket and 250# internal pressure
1—Steel & Alloy Tank Co. 100 gal. type 347 SS pressure tanks, 250# pressure
1—Steel & Alloy Tank Co. 350 gal. type 347 SS pressure tank, 250# pressure
1—Steel & Alloy Tank Co. 125 gal. type 347 SS jacketed autoclave, 250# internal and jacket pressure
1—Steel & Alloy Tank Co. 225 gal. type 347 SS jacketed autoclave, 250# jacket and 250# internal pressure
1—Steel jacketed reactor with turbine type agitator, 3500 gal.
1—Blaw Knox 400 gal. steel jacketed autoclave, 570# internal pressure, 85# jacket
2—Pfaudler 500 gal. glass lined reactors, complete with anchor type agitators and drives
1—Columbia Engineering high pressure storage tank, 2400 gal. 265# working pressure

DRYERS

1—Link Belt steel roto louver dryer, model 1003-30
4—Link Belt steel roto louver dryers, Model 207-1, 310-16, 310-20, 604-20
1—Buflovak double drum dryer, 42" x 120"
1—Stokes Model 59DS steel rotary vacuum dryer, 5' x 30'
1—Stokes double drum dryer, 5' x 12'
1—Louisville rotary steam tube dryer, 8' x 45'
1—Louisville SS rotary kiln, 30" x 28', complete
1—Louisville rotary dryer, 38" x 40', Type L
3—Louisville SS rotary dryers, 8' x 50'
1—Ruggles Coles 4' x 30' rotary kiln
1—Traylor 4' x 40' rotary dryer
1—Swenson 10' dia. spray dryer
2—Rotary dryers, 6' x 36'

FILTERS

3—Dorco rubber covered filters, 6' x 2'
1—Sweetland #3 SS filter
1—Niagara SS filter, Model 510-28
1—Oliver horizontal filter, 3'
1—Feinc SS rotary vacuum string filter, 3' x 3' (NEW)
10—Shriver plate and frame filter presses, 12" to 42"
12—Sweetland #12 filters with 72 SS leaves
1—Shriver rubber lined filter press, 36" x 36"
2—Niagara SS filters, Model 368-H

THE GELB GIRL—AUGUST 1959

MIXERS

2—Sturtevant #7 Dustless type 304 SS batch blenders, (NEW)
1—Readco SS jack. vac. sigma blade dble. arm, 25 gal.
3—Robinson type 316 SS sigma type jack. heavy duty, 400 gal.
5—Baker Perkins double arm sigma blade mixers, 100 gal.
1—Patterson Monel double cone blender, 4 cu. ft.
19—Robinson SS horizontal Blenders, 255 cu. ft.
1—12' x 4' type 316 SS Pug Mixer
1—Munson rotary blender, 40 cu. ft.

MISCELLANEOUS

1—Ames 300 HP steam generator, 150#
1—Cleaver Brooks 500 HP package steam generator, 200#
2—Heat Transfer Products steel bubble cap columns, 36" and 42" with 5 and 10 trays
1—Acme steel bubble cap column, 42" dia. with 10 trays
2—Patterson-Kelley steel heat exchangers, 1000 sq. ft. each
6—Struthers Wells heat exchangers, 885 sq. ft.
1—Patterson-Kelley steel heat exchanger, 427 sq. ft.
50—Steel heat exchangers from 15 sq. ft. to 400 sq. ft.
1—Struthers Wells type 316 SS heat exchanger, 330 sq. ft.
10—Davis Engineering type 316 SS heat exchangers, 85 sq. ft. to 170 sq. ft. (NEW)
1—Badger type 316 SS bubble cap column, 42" dia. with 11 trays
1—Badger type 316 SS bubble cap column, 36" dia. with 8 trays
1—Vulcan SS bubble cap column, 4' x 28 plates
3—Robins shaker screens, SS, 3' x 6'
1—Stokes Model DDS2 rotary tablet press
1—Struthers Wells SS calandria type evaporator, 365 sq. ft.
1—Swenson type 316 SS vacuum crystallizer, 3'6" x 12'
1—Swenson type 316 SS vacuum crystallizer, 2' x 12'
1—Swenson single effect evaporator, SS, 320 sq. ft.
1—Blaw-Knox steel distillation col. 36"x40', 24 trays, comp. (NEW)
3—Williams type 316 SS hammermills, Model AK
1—Mikro Model 4TH pulverizer
7—Milton Roy Proportionating pumps, SS, 1½ GPH to 156 GPH

1—Tolhurst 40" suspended type centrifuge, perforated basket type 316 SS, complete with motor and plow.
1—Tolhurst 40" suspended type centrifuge, perforated basket type 347 SS complete with motor and plow.
1—Oliver SS Rotary vacuum precoat filter, 3' x 6'.
1—Patterson-Kelley 6000 gal. steel jacketed reactor, 40# jacket, complete with agitator and drive, ASME Code.

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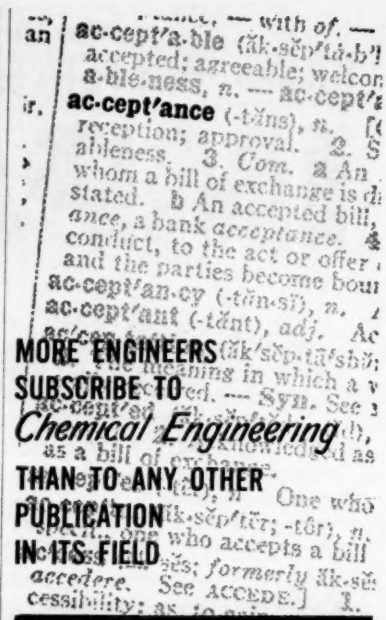

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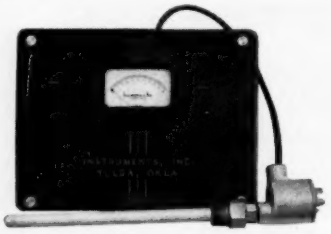

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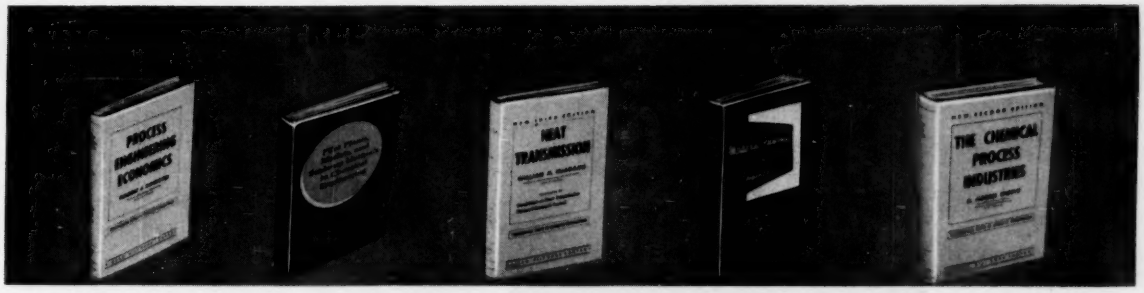

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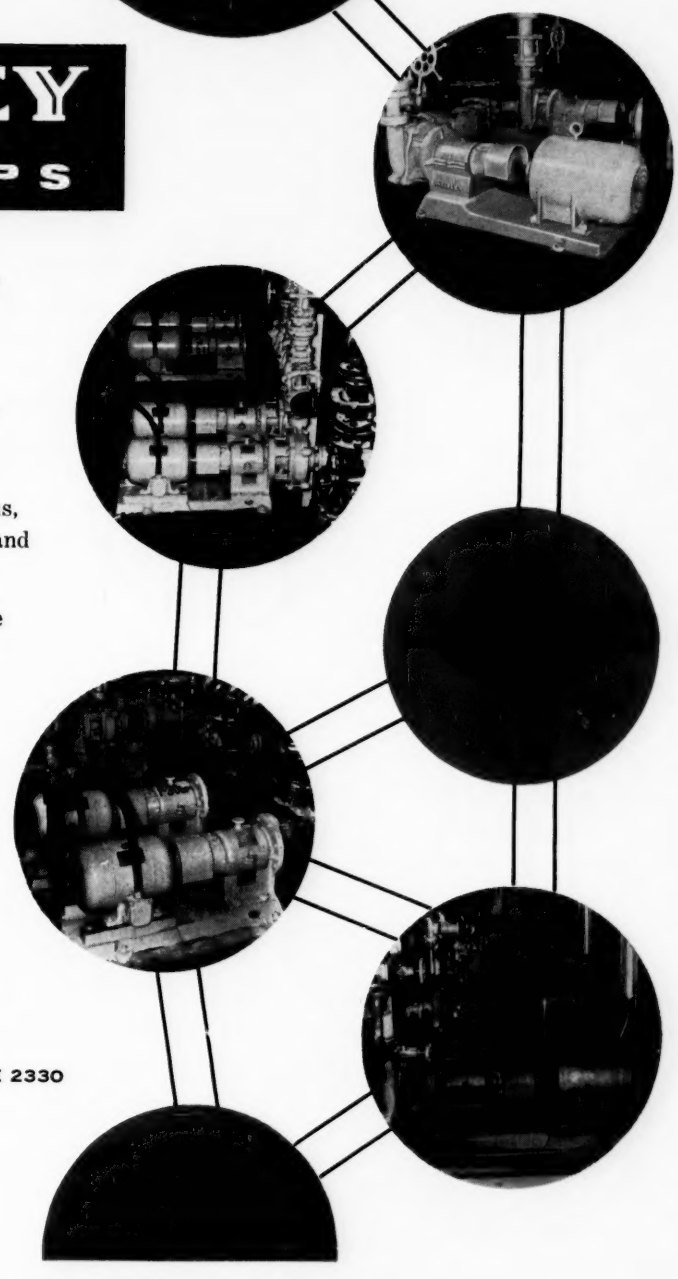

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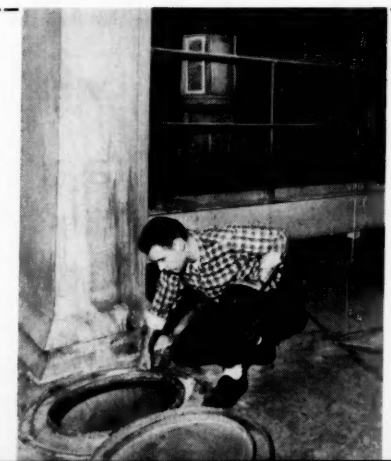
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